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Plastics

ALING WITH THE MANUFACTURE USES AND POTENTIALITIES OF PLASTIC MATERIALS

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Plastics

Dealing with the Manufacture, Uses and Potentialities of Plastic Materials

Vol. IV. FEBRUARY, 1940 No. 33

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TEMPLE PRESS LIMITED
Proprietors, Printers and Publishers of "The Motor," "The Light Car," "The Commercial Motor," "Motor Cycling," "Cycling," "The Motor Ship," "The Motor Boat and Yachting," "The Oil Engine," "The Aeroplane" and "Light Metals."
Bowling Green Lane, London, E.C.1.

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THE MATERIAL OF INFINITE USES

Vol. IV. No. 33 FEBRUARY, 1940

Plastics

Dealing with the Manufacture, Uses and Potentialities of Plastic Materials

Proprietors - - TEMPLE PRESS LIMITED
Managing Director - ROLAND E. DANGERFIELD

Editor - - M. D. CURWEN, B.Sc., A.I.C.
Offices - Bowling Green Lane, London, E.C.1

CELLULOSE ACETATE

IT has generally been assumed by many workers, both outside and inside the plastics industry, that the use of acetate sheet is very circumscribed and limited to those applications where the material undergoes the minimum of stress, or none at all. This is probably due to the fact that in the first instance cellulose acetate was conceived as a non-inflammable substitute for celluloid, which itself was circumscribed in use.

One may add that, were celluloid not inflammable, wider uses would long ago have been discovered and applied, so great are its virtues of strength and mouldability. There is little consolation, however, in this thought.

To-day, while it is true that the field for cellulose acetate is far from being unlimited, it is equally true that it is not confined as that for celluloid, and that it is steadily growing larger.

In the main, this change has been due to the aircraft industry, which saw the utility of making windows, windscreens, edges for wings and the like, where glass could not be employed. Designers were given a material reasonably transparent, light in weight, one that would not break easily and certainly would not splinter dangerously. But of these applications it cannot be said that the sheet is utilized at points under stress, for the forces exerted on a windscreen are comparatively small.

On the other hand, and strangely enough, for the aircraft industry is based so firmly on engineering and therefore mathematical science, there seems to have been little consideration by designers for those parts that are secondary to the main construction, forgetful, perhaps, that secondary parts may affect the primary ones. On the whole, it seems as if the process of thinking was, "The main construction must be extremely strong and the secondary ones must automatically be so." Obviously, however, although all must be considered in ratio to one another, yet each part must also be considered separately.

Furthermore, with regard to plastics, designers have been, until recent years, more or less completely ignorant of their properties and capabilities, and, with special reference to cellulose acetate, have, without knowledge of its strength, been content to relegate it to the role of "transparent window material." It is true they have been delighted, and perhaps surprised, that it can be moulded into a double curvature for their very express needs, but their delight and interest went little farther.

Few inquired its properties, other than transparency and specific gravity, and fewer knew or cared that the tensile strength is about 6,000-11,000 lb. per sq. in., that it has a high impact strength among plastics and a modulus of elasticity of considerable interest to them. Strangely, too, they appeared completely ignorant that such a material as an opaque cellulose acetate could exist, or where it could be employed with considerable advantage, economic and otherwise.

The first signs of acceptance of cellulose acetate for other than what might be called mere windowpane substitutes were first seen by us in the works of Plastilume Products, Ltd., and Hadley Co., Ltd., in the form of small ventilators and lamp-holders, while, again at Hadleys, we saw the manufacture, in black acetate sheet, of a machine-gun belt chute. This introduction was extremely important, for the chute is obviously under stress, although perhaps not great stress. In addition to its mechanical strength, cellulose acetate had been chosen for the ease of manufacture of the chute—readers may remember that it was made in a twisted curve about 6 ft. long—and could easily be repaired in situ if damaged. In addition, it was much lighter and probably cheaper than when made in any other material.

More recently an important factory has been erected in Dunstable for acetate working—Thermo-Plastic Products, Ltd. There would, however, be little of importance or significance in these works were it not for a very interesting fact. Its technical director, a Mr. Lewin, was, until recently, on the staff of Handley Page, Ltd., and he has considered cellulose acetate important enough to begin the manufacture of aeroplane parts and accessories that have hitherto been considered the province of structural materials other than plastics.

We regard, then, Mr. Lewin's entrance into the plastic industry with pleasure, not merely for the sake of swelling the ranks of manufacturers, but because he can, with his knowledge of both sides, occupy just that intermediary position between the aircraft and our own industry that has been lacking, explaining the peculiar properties of plastics to the aircraft designer and the desires of the aircraft designer to the plastics industry. On another page in this issue we relate what he has

already achieved at Dunstable in spreading the use of acetate for lightly and medium stressed parts.

There is this to add and to urge the aircraft and, indeed, all other industries to turn some of their attention to plastics. At a given stage in the life of a material it is often the habit to regard that stage as one of finality. This is far from being true with plastics, although few, even in the plastics industry, can look into the future and see what developments will take place.

But already in the very type of material we are discussing there is change. A new modification of cellulose acetate, namely, cellulose acetate butyrate, has appeared in the U.S.A., with some mechanical properties superior to the normal acetate. It is claimed that it possesses greater weathering resistance, lower water absorption and greater resistance to torsion than cellulose acetate.

There is no such thing as finality in our industry.

Plastics in Germany

OUR worthy contemporary, *The Beetle Magazine*, in its Christmas issue has gone to considerable trouble in translating some valuable information regarding this subject from the *Reichsanzeiger* of October 4. The information contained therein throws a light on the manner in which industry is controlled in that country; it forms part of an Enactment by Dr. Claus Ungewitter, the Reich Leader for Chemistry. We are indebted to the Editor of *The Beetle Magazine* for permission to make the following abstracts:—

Art. 1. The following provisions relate to phenol, cresol or urea synthetic resins, with the exception of lacquers made from synthetic resins and plastic substances, for the manufacture of which use is made of phenol, cresol or urea resins.

Art. 2.

(1) It is prohibited to utilize synthetic resins and plastic substances for converting them into:—

(a) Articles of jewellery or ornaments.

(b) Articles for packing (with the exception of tubes and other containers with screw caps, boxes for typewriter ribbons, and packings for chemical pharmaceutical products).

(c) Household articles and other articles of daily use (with the exception of shaving sets, shaving soap cases, soap boxes, ashtrays, jugs, funeral urns, drinking goblets, butter dishes and tableware, not exceeding 15.5 cm. in diameter, provided, for the manufacture of the three last-mentioned types of article, plastic substances derived from urea are employed).

(2) In certain special cases the National Office may allow exceptions to the provisions in Article 1.

(3) The provisions contained in Article 1 do not apply to orders for the Army or orders for export.

Art. 3. Manufacturers of synthetic resins or plastic substances may not employ or deliver such products except with the authorization of the National Office for "Chemistry."

Art. 4. Any person who obtains delivery of synthetic resins or plastic substances must, when placing his order, furnish the supplier with the following details:—

1. If it is a question of orders for the Army: the number of the order and the address of the Army Bureau from which it emanates.

2. For all other orders:—

(a) An exact description of the articles for the manufacture of which the resin or plastic substance is to be employed;

(b) If possible, the name and address of the purchaser of such articles.

3. The details referred to in numbers 1 and 2 may, in certain special cases, be furnished direct to the Distribution Bureau for resins and plastic substances.

Art. 5. Resins and plastic substances purchased in accordance with Art. 4 may not be utilized for the manufacture of articles other than those indicated in the order, without the express authorization of the Distribution Office.

Art. 6. The provisions of Articles 3 and 4 do not apply to monthly supplies of less than 50 kgs. per buyer or consumer.

Article 2 is extremely significant, not to say surprising. Metals for the purposes indicated are not available and it has been assumed that there are ample supplies of phenol and cresol in the Reich to replace them. There may, however, be a shortage, especially of formaldehyde. We cannot imagine a shortage of urea, except in so far as the chemical labour and supervision is required elsewhere. The distinction between phenolic and urea resins in Art. 2 (c) is noteworthy.

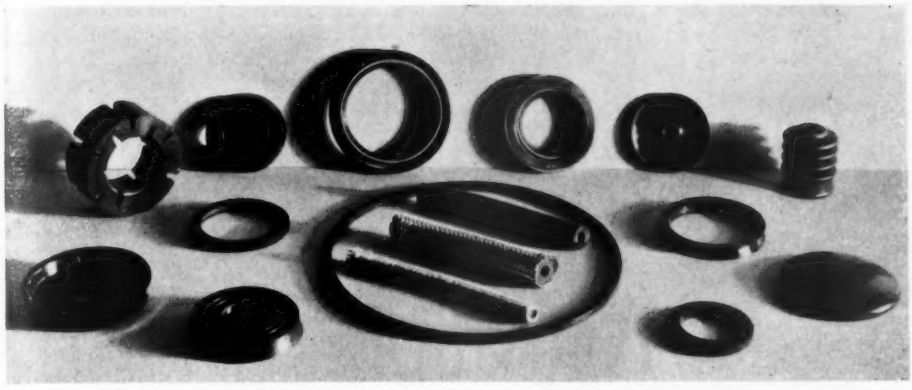
It would appear that almost everything is subsidiary to the war effort in armaments. As for exports, these receive special consideration, but they must have dwindled to a very small fraction of pre-war days now that the economic warfare is so bitter.

The results of this Order will be disastrous for some branches of industry and a change-over to urea plastics not very welcome to others from the point of view of cost. The Four Year Plan has received a serious blow.

On the whole, we presume that Germany is intent on conserving her stocks and is not suffering severely from a shortage of plastics. She was always a great producer of phenol, cresol, urea and formaldehyde, and since the various Plans began has concentrated on the plastics made from them and on polystyrene, polyvinyl resins, methyl acrylic resins, synthetic rubbers, etc. She avoided as far as was possible celluloid and cellulose acetate as a stand-by for war and relied on materials that could be made from indigenous products, such as coal and the nitrogen extracted from the air. Although huge stocks of cotton for the all-important explosives and nitro-cellulose dope must have been stored, it would be remarkable if there were sufficient for a prolonged war. A substitute, such as wood or straw, for these purposes is, of course, theoretically possible and considerable research work has been done on the subject. So far as our information goes, however, the cellulose so obtained does not give sufficiently stable results, at least for the production of cordite and similar explosives.

Institute of the Plastics Industry

In spite of the difficult times, the Institute has arranged to hold an informal meeting on Thursday, February 8, at which a topical subject will be open to free discussion. The subject has the intriguing title, "What About Afterwards?" and several people well-known to the industry, including Major Knowles, Mr. T. L. Birrell and Mr. E. J. Lassen, have promised to contribute introductions to the subject preparatory to free and open discussion. The meeting will commence at 8 p.m. at "The Victoria," 56, Buckingham Palace Road, London, S.W.1 (corner Lower Belgrave Street, near Victoria Station). It will be preceded by an informal supper, the cost of which will be 2s. 6d. per head.



Examples of "Gaco" mouldings which are now finding many important applications in modern industry particularly where high resistance to oil is the first requirement.

"GACO" SYNTHETIC RUBBER

GEORGE ANGUS AND CO., LTD., of Newcastle-on-Tyne, may be described as the pioneers of synthetic rubber in Great Britain. Their series of synthetic rubber compounds, already well known under the registered Trademark "Gaco," were evolved after years of research work and first introduced on a commercial scale as early as 1936. For the manufacture of these products, modern works were erected in Tyneside. For the processing of "Gaco" and in order to exploit fully its new and valuable properties, special machinery and plant was designed and installed. As is well known, there existed for many years a strong and unsatisfied demand for a rubber-like material without the limitations of rubber as regards resistance to oils, fuels, heat, friction, ageing, etc. Consequently, when "Gaco" was first available to engineers they were quick to realize applications in their respective spheres and many intricate and worrying problems were at last solved efficiently and simply. Very little sales propaganda was, therefore, required to market "Gaco," and the rapidly increasing demand for "Gaco" products kept the manufacturers fully engaged with the necessary expansion of plant and production facilities.

"Gaco," although its physical properties are similar to those of rubber, contains no rubber at all, it is, in fact, a polymer of butadiene derived from acetylene gas. Whereas natural rubber perishes at temperatures near or above the boiling point of water and deteriorates under the influence of oils or fuels, "Gaco" will withstand satisfactorily 300 degrees F. dry heat and over 400 degrees F. in the presence of oil. It is also resistant to aliphatic hydrocarbons, such as petrol, paraffin. Diesel oil, and is little affected by the majority of organic solvents. "Gaco" is grainless, non-porous and highly resistant to abrasion, which, in combination with its low coefficient of friction, makes it ideal for high-speed sealing applications where leather or rubber have been used unsuccessfully in the past.

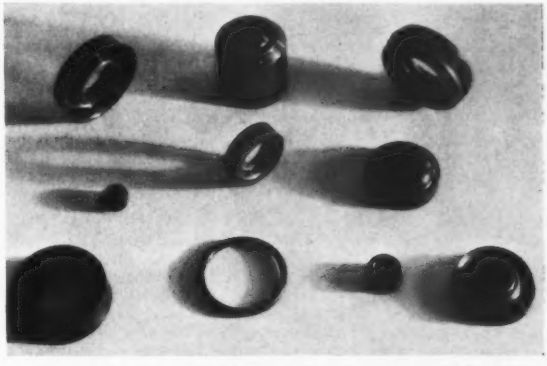
By using heavy hydraulic pressure and heat, "Gaco" is moulded in an infinite variety of shapes in polished steel moulds which are machined to fine limits. "Gaco" mouldings have a high, almost mirror-like surface finish comparable with that of a new gramophone record, which in itself speaks for the excellent quality and homogeneous nature of the material. Knife edges, frequently required for wiping or sealing purposes, can be produced on "Gaco" mouldings without difficulty.

This particular synthetic rubber, which has a base very similar to the German Buna rubber known as "Perbunan," can easily be distinguished from natural rubber, first because, unlike rubber, it is practically odourless, and secondly because it is not thermoplastic. On burning or being subjected to excessive temperatures, it hardens and eventually carbonizes instead of softening. "Gaco" can only be ignited with difficulty and when burning it gives off smoke which has a characteristic odour, resembling that of an extingiushed candle.

Moulded parts are made in hardnesses ranging from that of soft rubber to that of vulcanite, i.e., 30-100 Shore Durometer readings. Elastic elongations up to 1,000 per cent. are obtainable with the softer grades and tensile strengths up to two tons per square inch can be reached.

Where protection of machinery parts against the ageing influence of light, oxygen, ozone, atmospherics or the corrosive effects of steam, sea-water, dilute acids or fumes is required, specially designed protectors moulded from "Gaco" are widely used.

Unlike rubber, "Gaco" is a semi-conductor of electricity and a good heat conductor. Its low specific gravity of approximately 1.4 renders it particularly valuable where weight reduction has to be considered. For this reason "Gaco" is widely used in the design of aircraft where only materials of the highest grade may be employed. In spite of the higher initial cost of "Gaco" parts, the use of "Gaco" is economical in the long run in view of its greatly superior life and wearing properties and the saving of costly replacement work.



Group of small mouldings of "Gaco" rubber made by George Angus and Co., Ltd.

"Gaco" parts are frequently used on plant where time lost by replacing defective parts leads to costly hold-ups in production, e.g., steel rolling mills, hydraulic and pneumatic installations, etc.

By special processes it is possible to bond "Gaco" to metals, in spite of the fact that "Gaco" is chemically inert and has no natural tendency to bond or adhere to metal surfaces even when it is at rest and under load. "Gaco" is widely used in oil seals where moulded "Gaco" sealing members having spring-loaded lips are incorporated in metal shells to form self-contained sealing units. Angus oil seals have innumerable uses in machinery of every description where retention of oil and exclusion of foreign matter from bearings, etc., are important.

As will be realized, "Gaco" lends itself to the production of extruded sections such as tubing and profile strip. It is also manufactured in the form of sheet.

Gift Containers

Several prominent manufacturers, such as Tootal Broadhurst Lee Company, Ltd., Stanley Dawson and Co. and C.P.A., Ltd., are making use of moulded boxes for their handkerchiefs. These mouldings are claimed to be popular with retailers and the buying public, and it is expected that greater use will be made of them as seasonable packs

THE merits of the moulded container as a seasonable gift pack for handkerchiefs are now fully recognized by such prominent concerns as Tootal Broadhurst Lee Co., Ltd., Stanley Dawson and Co., and C.P.A., Ltd. Although our memory is by no means infallible, we believe that the first box was put on the market in 1936 by Tootals, who, ever since, have been staunch supporters of the plastic pack, using it not only for their "Lissue" handkerchiefs, but also for the famous "Pyramid" gents' and ladies' handkerchiefs.

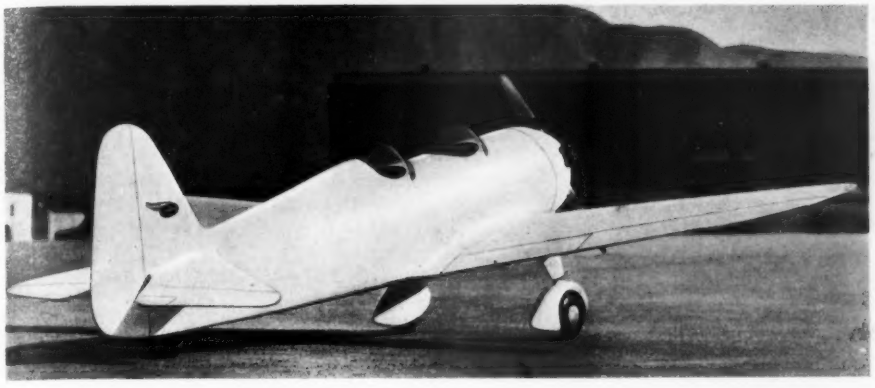
Several well-known moulding concerns have taken an active part in the development of these very popular plastic re-use containers, particularly The Streetly Manufacturing Co., Ltd., and Insulators, Ltd., who have collaborated in designing what is generally considered as attractive and yet practical shapes. The advantages which can be claimed for the moulded pack as a seasonable method of presenting handkerchiefs may be briefly summarized as follows:—

1. Attractive shape and pleasing colour.
2. Re-use properties. The ashtray type of box, which was moulded by Insulators, Ltd., and created by designers of Tootal Broadhurst Lee Co., Ltd., working in collaboration with the moulders, is a good example of a popular and useful pack. The hinged box with a black Scarab base and ivory Beetle lid, moulded by Streetlys for Tootals, is also an outstanding production and finds a useful place on the dressing table as jewel casket or receptacle for various knick-knacks.
3. Light weight and low freight charges.
4. Economy of production.

Retailers are very favourably inclined towards these plastic containers for several reasons, the most important being that they do not get dirty and shop-soiled as easily as cartons and may be used to build up sales-promoting counter and window displays. According to conversations we ourselves have had with shopkeepers, there is no doubt that plastics do, in this instance, contribute quite appreciably to the popularity of handkerchiefs as gifts. In spite of the war we expect to see many moulded packs in 1940.

The box shown on the extreme left was moulded by Insulators Ltd., of Bakelite, for Tootal Broadhurst Lee Company, Ltd. The hinged box on the right, moulded by The Streetly Manufacturing Co., Ltd., for the same company and the one in the foreground also moulded by the same concern for handkerchiefs made by Stanley Dawson and Co.

This series of boxes with decorated lids were moulded by The Streetly Manufacturing Co., Ltd., of Beetle and Scarab, the former being used for the lid, for Stanley Dawson and Company for packing their well-known "Exelda" handkerchiefs. This series of packs is made up with a number of different decorative lids depicting various sporting activities.



Close-up of the all-plastic Timm trainer now being produced in California by the Timm Aircraft Corporation. Impregnated spruce plywood is used for the manufacture of the machine.

THE TIMM TRAINER

NEWS has just been received from California that an all-plastic aeroplane has been successfully constructed by the Timm Aircraft Corporation. Although, naturally, particulars regarding the process are rather guarded, some interesting details have been released for publication.

Briefly stated, the method of manufacture makes use of a triple criss-cross laminated spruce plywood which is heavily impregnated with phenol-formaldehyde in the form of a solution in alcohol or other suitable solvent. The resultant sheets may then be formed to the desired shapes by a process for which patents have been applied. The number of degrees of heat required, as well as the amount of pressure necessary, are two of the manufacturing secrets which are not being divulged. Prior to the moulding process, however, these sheets are stamped out in desired shapes by the use of dies and presses, which are heated for the operation.

The wing is of full cantilever construction. The skin is formed of two moulded halves fitted over the conventional type of spars and ribs, and bonded and sealed at all points of contact by the same phenol process. Laminated solid rectangular Nuyon processed spruce spars are used, and the ribs are of three-ply web of resinous bonded plywood.

The fuselage, which is of semi-monocoque construction, is shaped in two half-sections, and these are united into the structure by an ingenious process, thus forming a shell, which, in the case of a training aeroplane, could accommodate engines ranging in power from 125 to 225 h.p. without additional stressing.

According to O. W. Timm, president of the corporation, the use of plastics in aircraft construction has many advantages over the more generally adopted all-metal types. Primary among these, he says, is that it would lend itself to virtual mass production in a time of national emergency, and at the same time produce an aeroplane which, if subjected to minor damage by rifle fire or shrapnel, could be repaired on the field by a simple process and immediately returned to service. Major damage does not need the facilities of the complete repair shop which the all-metal aeroplane requires.

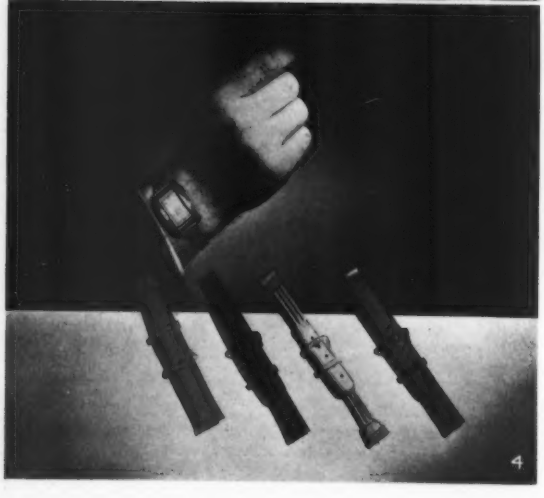
Other advantages of the planes are that they resist heat, salt water, oil and gasoline, and the aerodynamic efficiency is greatly increased owing to the elimination of exposed rivet heads and seams common in metal construction. Secondly, there is a definitely reduced labour cost, resulting from the greater ease with which the wood-based plastic can be worked and formed. This saving is naturally reflected in the selling price, and it is estimated that an advantage up to, perhaps, 25 per cent. may result to the consumer.

The initial product of the Timm factory is a two-seat, open tandem, military-type training monoplane designated as the PT-160-K. It has a span of 35 ft., an overall length of 26 ft. 4 ins., and stands 7 ft. in height. The wing is an NACA 23015 airfoil at the root and tapered to NACA 23013 at the tip. The aeroplane empty weighs 1,363 lb. and provides for a useful load of 662 lb. The company plans to produce these trainers with engines from 125 to 220 h.p.

Performance, based on 160 h.p., is estimated as follows:—High speed at sea level, 137 m.p.h.; landing speed, 48 m.p.h.; climb at sea level, 1,026 ft. per minute, and to 10,000 ft. in 14.4 minutes; service ceiling, 17,800 ft., and a cruising range of four hours or 500 miles.

Upon completion of the trainer Timm officials expect to start construction on a military aeroplane of the same materials, which will be based on a revision of the Howard Hughes racer, which now holds the west-east transcontinental record of seven hours and twenty-nine minutes. Design rights to this were recently purchased by the Timm organization, and the revised engineering and design have been completed. In this a 1,250 h.p. engine will be installed, capable of 400 m.p.h.

This sketch shows the simplicity of design of the Timm trainer.



"Modern Plastics" Competition

A further selection of prize-winning entries in the 1939 "Modern Plastics" Competition. Previous entries were published in the December and January issues of this journal

1

A revolutionary improvement in the structure of tennis and squash rackets, invented by Mr. J. L. Kleinman, of 1, East 42nd Street., N.Y.C., U.S.A., and made by Ken-Wel Sporting Goods Co., of Utica, N.Y., under the trade name of "Duracket," has been enthusiastically adopted by tennis and squash devotees. These rackets had equal appeal to judges of the Fourth Annual "Modern Plastics" Competition, sponsored by *Modern Plastics* magazine, who gave it one of the chief awards in the group of Miscellaneous entries. The outer periphery of the frame of the "Duracket" is provided with a strip of laminated plastic material, shielding and strengthening the weakest portion of the racket to an extent whereby the strings will be supported in their position and will not cut nor sink into the wood between string holes and loosen.

2

Popular among racing fans in America are the "Balar" field glasses which recently received a major award in the Scientific section of the Fourth Annual "Modern Plastics" Competition. This binocular, produced by Bausch and Lomb Optical Co., Rochester, N.Y., U.S.A., was designed to offer a small field glass of fine quality which may be carried safely and easily in a pocket or purse. The rectangular shape permits a wide field of vision rather than a large circular field—a definite advantage for all sports purposes. Of Bakelite moulding material—supplied by Bakelite Corp., New York City—the glasses are light in weight and practical to use.

3

Familiar to automobiles all over the U.S.A., the A A A insignia, denoting membership in the American Auto Association, has been transformed completely in appearance. The redesigned emblem created, developed and sold exclusively by Clif H. Murfin Co., Portsmouth, Ohio, was deemed deserving of one of the chief awards in the Transport classification of the "Modern Plastics" Competition. The cut-out letters "A A A" in the centre, with the words "Auto Club" below and the name of the club above printed in colour against a light background, combine to make this new emblem neatly simple and clearly legible even from a distance. Moulded of Lumarith, manufactured by the Celluloid Corp., New York City, the insignia is sturdy and serviceable and will, it is believed, outlast in usefulness and appearance the metal previously used. It is being moulded by Kilgore Mfg. Co., Westerville, Ohio, and the dies for the pieces were built by the same concern.

4

Utility of material and style importance combined to win for the watch-strap buckles and slides developed by

American Strap Co., Inc., New York City, one of the principal awards in the Novelty group of the "Modern Plastics" Competition. Entirely in keeping with present-day trends, these little buckles and slides have many superlative qualities that undoubtedly will keep them busy in the world of fashion. To begin with, they will never corrode or tarnish, nor will they stain the wrist with ugly greenish-hued blotches as so often happens with metal fastenings. Moisture or perspiration does not affect their softly tinted surfaces in the least, and they never feel cold or clammy to the touch.

5

Each half depicting three dolphins riding on the crest of a wave the plastic bookends cast in rubber moulds by C. K. Castaing Studio, Stony Brook, N.Y., U.S.A., was the only entry to receive Honourable Mention in the Decorative Cast products group of the Fourth Annual "Modern Plastics" Competition. The plastic material used for the bookends is Marblette, supplied by the Marblette Corporation, Long Island City, N.Y.

6

A compact, sanitary toilet accessory especially attractive to travellers, the Denta-kit toothbrush won for its sponsor, Violette, Inc., Chicago, Ill., a major award in the Novelty division of the 1939 "Modern Plastics" Competition. Designed by Richard J. Violette, Virginia, Minn., this entry combines a carrying case, replaceable brush end and a container that holds enough dental powder to last a week or ten days—all within the dimensions of an ordinary toothbrush. The toothbrush is so balanced that the bristles always remain upright whenever the brush is laid down on the bathroom shelf. Made of Tenite, a plastic material manufactured by Tennessee Eastman Co., Kingsport, Tenn., these toothbrushes are smooth and clean-looking, pleasant to handle, and can be had in any favourite colour. They are being injection moulded by Chicago Molded Products Corp., Chicago, Ill., on a press supplied by Reed-Prentice Corporation, Worcester, Mass., U.S.A.

7

Developed for the protection of the cyclist—and autoist, too—the Delta Guardlite received a major award in the Transport classification of the "Modern Plastics" Competition. The lustrous black shell and brilliant red lens of this tail light, designed by Barnes and Reinecke, Chicago, Ill., U.S.A., for Delta Electric Co., Marion, Indiana, give convincing evidence that even inexpensive and commonplace things need not be ugly in appearance. Optically moulded for reflective power, the lens part of the lamp which extends around the sides allows the light to shine on each side of the road as well as to the rear. Both shell and lens of the Delta Guardlite are moulded of Tenite, a plastic material made by Tennessee Eastman Corp., Kingsport, Tenn., and are proof against rust and corrosion, the two most prevalent troubles with bicycle lights. Chicago Molded Products Co., Chicago, Ill., injection moulds the parts on a press built by Reed-Prentice Corp., Worcester, Mass., U.S.A.

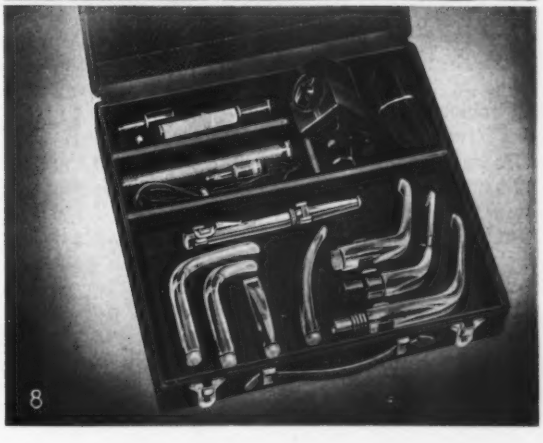
8

The development of a new material which multiplies the use of an older plastic application won recognition in the Fourth Annual "Modern Plastics" Competition. The Surgical Master Kit, made by Curvlite Products, Inc., of New York, originators of cold light plastics instruments, was judged worthy of honourable mention in the Scientific group because its instruments were made of a new heat-resistant plastic which could be sterilized by boiling in water. Made of boilable Plexiglas, developed and manufactured by Rhom and Haas, Philadelphia, Pa., U.S.A., the instruments will not conduct heat or electricity and are unbreakable.

5

6

7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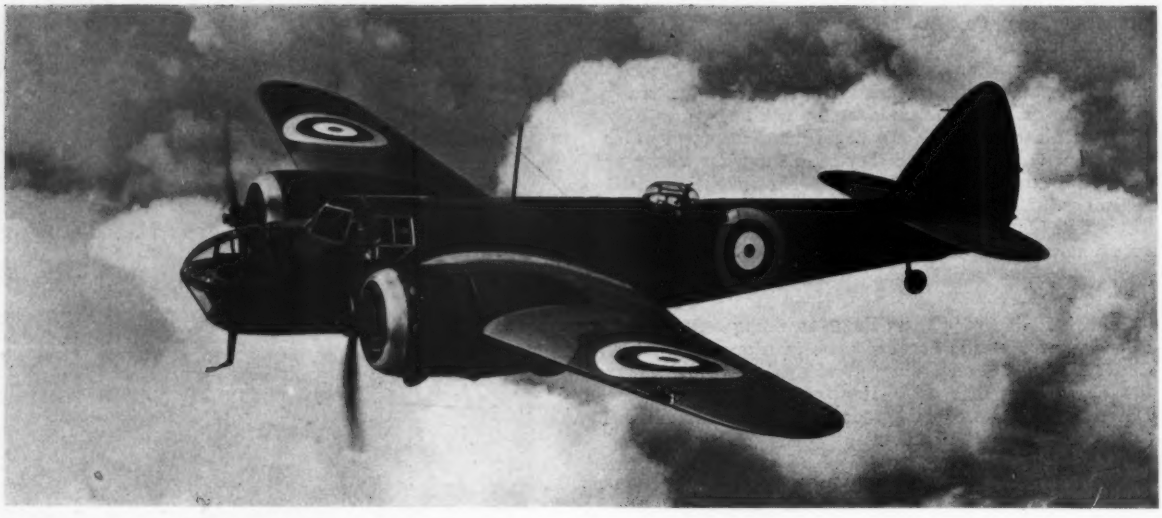


CELLULOSE ACETATE IN AIRCRAFT MANUFACTURE

A brief summary of the advantages which can be claimed for cellulose acetate mouldings in aircraft construction

IT is a rather lamentable fact that aircraft designers and draughtsmen have a very limited knowledge of plastics and, in consequence, the best possible use is not always made of the most suitable and economic materials available. This is particularly the case in regard to cellulose acetate, which although well known in the transparent form for hoods, windows, turrets and many other parts, is not yet being fully exploited in the form of black pigmented sheets complying with Air Ministry Specification D.T.D.315. It is significant that the Air Ministry has recently sent to aircraft manufacturers a circular letter stressing the importance of using this material as an alternative to aluminium alloys. This letter states: "Whilst it is realized that the most promising field of successful and relatively easy substitution may be in connection with lightly stressed and unstressed parts, it is desired to emphasize that no part should be omitted from this survey. . . . Where stressed parts offer any possible scope for substitution, advantage should be taken of the possibility and the necessary technique developed to suit the characteristics of the alternative materials. Although the development of the technique may take some time, it is desirable to initiate the work, as the experience gained will have application in new designs."

It was our privilege a few days ago to visit the works of Thermo-Plastic Products, Ltd., Dunstable (associated with Sign Trade Supply Co., Ltd., London), a firm specializing in ambitious aeronautical work in black acetate sheet, and to obtain at first hand a valuable insight into the working of this material and to learn also of its many advantages over metal. At the present time, applications are mainly confined to unstressed and lightly stressed parts, such as air ducts, scoops, fairings, spats, fillets and many small accessories, but already Mr. Lewin, technical director of this company, is carrying out experiments in co-operation with some large aircraft firms to perfect a moulded acetate spinner or hub for airscrews. At present this is made of duralumin. This plastic spinner has been scientifically designed so as to be able to withstand the high centrifugal force exercised when the airscrew is revolving at high speeds and also the vibration set up at slower speeds. So far, experiments have proved encouraging, and it is hoped that this moulding, probably one of the most important advances yet made in the fabrication of stressed parts, will prove satisfactory for use. A further advantage which can be claimed for the acetate spinner is its lighter weight as compared with one made of aluminium alloy. Another factor is that the highly polished surface of the plastic spinner is not favourable to ice formation, nor is it attacked in any way by the chemicals used to prevent this highly objectionable occurrence. Sea spray, sand, dust and other atmospheric impurities are also without effect on the surface of the moulding.

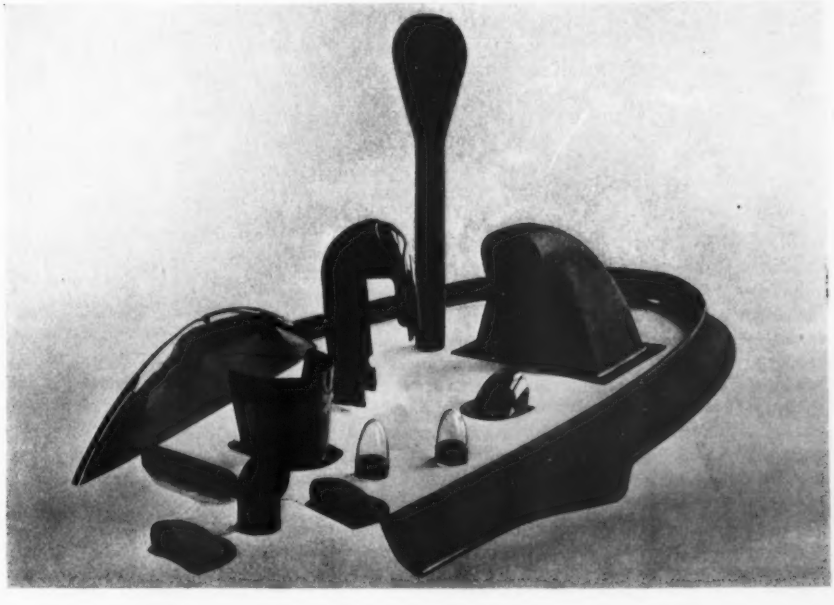
The advantages which can be claimed for the use of black acetate sheet for unstressed and lightly stressed parts are becoming more appreciated by those aircraft concerns who have had the benefit of exploiting them. Probably the most important, and certainly the most obvious, is the price factor. Although duralumin is at present 30 per cent. cheaper than black acetate, it is possible to produce acetate mouldings at a figure below that of metal parts and in far less time. One reason for this is that whereas with duralumin a very large percentage of waste occurs during the turning, drilling, milling and general machining operations which is as high as 80 per cent. (although the figure seems extraordinarily high), with acetate there is very little waste

This dinghy stowage box is probably one of the most complicated and certainly the most interesting acetate production yet designed. The dimensions of the box are 27 ins. by 21 ins. by 11 ins. deep.

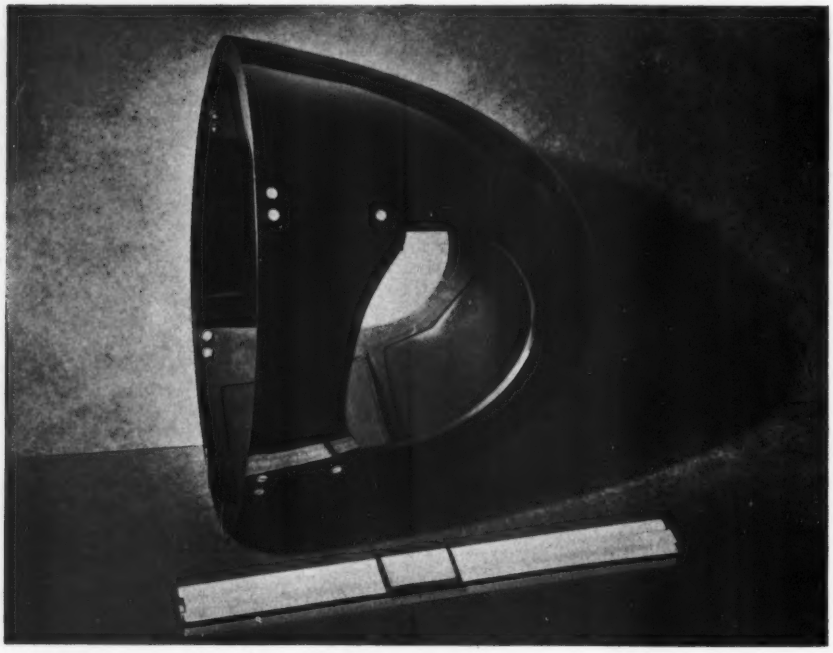
since the ease with which the material can be stretched and pulled round to take up the most intricate double-curved shapes, under proper treatment, enables one to make up components of single sheets instead of building them up of separate parts. Another reason for cheapness is that riveting is avoided, all jointing being done by cementing, using scarf or lap joints. But the main reason why acetate parts are more economical than similar ones made of aluminium alloys lies in the technique of its fabrication. Probably the most outstanding example is afforded by the fact that it is possible to produce wing tips 11 ins. deep spanwise and 4 ft. long in chord by deep drawing of sheet material in one operation, whereas with metal this would require several operations, welding of the leading edge being one. It is, therefore, not difficult to appreciate the reasons which are promoting increased interest in the future of this material.

From the designer's standpoint, the great asset of acetate mouldings is that they permit modifications in design without necessitating difficult and expensive alterations in equipment. Even when the acetate moulding is complete, pieces can be taken away, curves smoothed down and parts thickened without incurring any great expense or wasting a lot of time. This will be only too obvious to anybody who is acquainted with the numerous modifications to the design taking place in the course of the developments of any new aircraft type, some of which are slight and others of considerable importance. Where metal jigs or tools have to be changed, the cost and delay in production are often very serious.

Even for the production of large units, such as dinghy stowage boxes, fillets, wing tips or nacelle fairing, tool and jig costs are very moderate, as moulds are mostly made in hard wood. For this reason, it is possible to organize production so that delivery is made in a fraction of the time required for metal parts, presuming



A group of acetate accessories including a large fillet, air ducts, scoops, etc., moulded by Thermo-Plastic Products, Ltd., Dunstable.



The spinner fabricated of cellulose acetate is shown in this photograph, and alongside is an 11-inch rule. This spinner is at present undergoing stringent tests.

there is no delay in obtaining supplies of the light alloys, now in such great demand by the aircraft industry.

At the present time there is a growing need for extruded tubing for conduits and ducts previously made of metal. Until quite recently, no British manufacturer was able to supply the wide range required, and fabricators were forced to make their own tubing by longitudinal welding from the sheet, a rather cumbersome and expensive method compared with the quick extrusion process. Happily some progress is at last being made and the use of extruded acetate tubing is bound to develop.

In conversation with Mr. Lewin, of Thermo-Plastic Products, Ltd., the view was expressed that designers of the future will be forced to be influenced by the work now being carried out in plastics. Although it is not claimed that cellulose acetate has the same high mechanical strength as duralumin, its tensile strength is equivalent to that of aluminium and its resistance to corrosion and erosion much superior. It is to be hoped that when data on fatigue is available—and this is only a matter of time—acetate mouldings will find important applications for many stressed components.

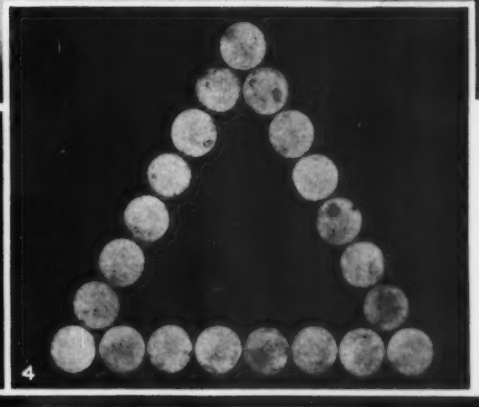
In conclusion, it is perhaps as well to explode one myth regarding the use of plastics in aircraft construction. It is often said by those who should know better that thermo-setting plastics, such as Bakelite, etc., are materials best fitted for mass production, and should, therefore, be ideal for the aircraft manufacturer. This would be true for production in numbers above the 10,000 line. But modern aircraft is not yet produced on mass-production lines; it is still in the series production stage. The reason for this is that no design can be standardized because modifications continually become desirable, especially during production as the result of experience, and therefore the whole system of production must be organized so that changes are possible. Under these conditions, thermo-plastics are by far the most important type of plastics used in the aircraft industry, and are probably the most adaptable materials in existence and in every way suitable for series production on the scale of 100 to 2,000.

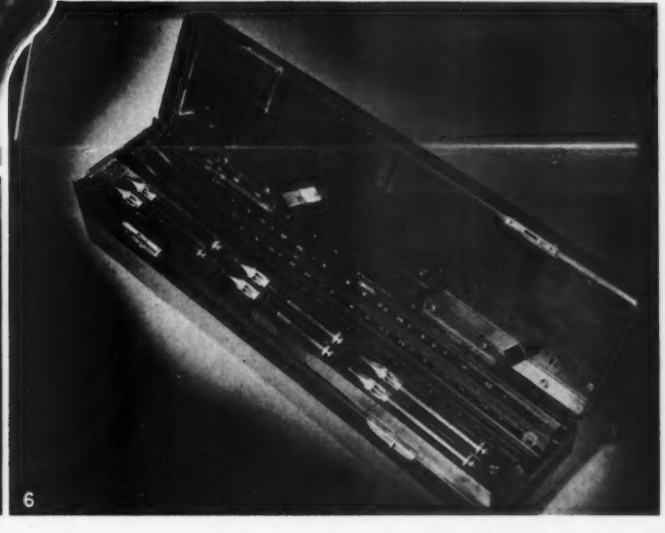
UREA RESIN IN U.S.A.

A very interesting survey of the progress made in the use of urea resins is given by M. H. Bigelow in "Modern Plastics," January, 1939. He states that urea laminations are being widely accepted by the trade, particularly for the manufacture of large panels, such as are used in the manufacture of refrigerators. These laminations are really two surfaces of urea-impregnated material between which is sandwiched a solid paper base, the final piece being white, opaque and quite similar in appearance to porcelain enamel. Another advance in the field of urea coatings is embodied in U.S. Patent No. 2,178,358, in which it is revealed that a permanent surfacing may be applied to phenolic and other suitable laminations by a spray coating method wherein a urea-formaldehyde resin surface is built up and pressed to set, yielding a final finish which has most of the properties of moulded ureas. Properly treated base sheets are covered with a facing sheet upon which has been sprayed an aqueous suspension of finely dispersed urea plastic substance. The sandwich is pressed between heated platens.

There has been an upward swing in the use of urea-formaldehyde-type adhesives for plywood and other similar gluing processes, this being due to the fact that in 1939 there were introduced on the American market new improved types of urea adhesives, suitable for both cold and hot pressing. The new glue is still a urea-formaldehyde type, but is available in the dry powder form. It dissolves readily in water and, prior to mixing, is stable for a year or more. Advantages claimed for the dry urea adhesive are greater stability, more uniform blending of urea resin with hardener, greater economy in transit and easier handling. It is thought that the introduction of this dry glue will still further increase the scope of urea-formaldehyde resins as adhesives.

NEW DEVELOPMENTS FROM BOTH SIDES OF THE ATLANTIC





(1) Laminated with Lumarith Protectoid made by Celluloid Corporation, U.S.A., the box and display will stay fresh and clean despite constant handling.

(2) These simple orange-tinted acetate shells fit over the head lights and spot lights of most cars and give a beam which, tests have shown, greatly increases visibility. The fog caps are made of Monsanto cellulose acetate.

(3) This ingeniously designed umbrella has a special handle of Monsanto cellulose acetate which contains a pair of light-weight rubbers.

(4) This sign, taken in complete darkness, is made of luminous urea powder moulded in the form of buttons and mounted on a board. N.B. Mouldings, Ltd., are the moulders concerned and they inform us that these buttons will be available for fitting to the threaded stem suitable for fastening to standard perforated sheet.

(5) Hygienic, useful and attractive are chief characteristics of this new pack for the well-known Halex toothbrush, manufactured by Halex, Ltd., a subsidiary of The British Xylonite Co., Ltd.

(6) In the 1938 All-America Package Competition, sponsored by "Modern Packaging Magazine," this compact Bakelite moulded case for Wrico lettering instruments won a first award in the Plastic Container Group.

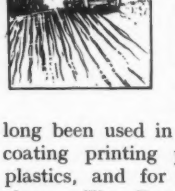
WORLD'S INDUSTR

TEXTILES

Chlorinated rubber is now being used as a flameproofing agent for textiles, states *The Textile Weekly*, January 12, 1940. In view, however, of the possibility of some decomposition on prolonged exposure to sunlight and damp, the risk of more or less serious tendering of fabrics cannot be entirely excluded. One method of avoiding this danger which has been developed in the United States consists in blending the chlorinated hydrocarbon (e.g., rubber, paraffin wax, vinyl resin, etc.) with a water-insoluble salt which does not evolve oxygen when heated and is fusible at the combustion temperature of the treated fabric. Chemicals satisfying these requirements are certain insoluble salts of boric acid, such as manganese and zinc borates. The latter have the further advantage of protecting textiles against mildew. Further protection of the chlorinated hydrocarbon against premature decomposition is provided by inclusion of pigments like iron oxide, tatanium white and antimony oxide. The proportion of proofing agent to fabric will vary with the type of fabric. On cotton duck, for instance, it should preferably not exceed the weight of the cotton itself, but a larger proportion is permissible on more open fabrics. Satisfactory flameproofing with retention of elasticity, strength and flexibility is obtained when using proportions of ingredients ranging within the following limits (calculated upon the weight of fabric)—chlorinated hydrocarbon 8-50 per cent., borate 1-30 per cent., pigment 4-40 per cent. This process is fully protected by U.S. Patent No. 2,172,698, 1939.

AIRCRAFT

Screw propellers made of plastics or rubber or combinations of these materials with light alloys are referred to in two recent British patents, No. 504,377 and 504,849. The first refers to a hollow airscrew blade which is formed from preformed complementary moulded plastic sections, the joint lines of which extend along the leading and trailing edges, the sections being homogeneously united under pressure. The plastic material comprises resinous or similar material of the thermoplastic or thermosetting type such as impregnated fibres of cotton, linen, or wood or laminated sheets of wood veneer and resin. The preformed sections are moulded between pairs of primary and secondary dies produced from a master pattern. Preformed struts may be incorporated in the blade or a permanent core of expanded rubber. The shank of the blade may be "upended" by means of an axially moving end mould. The second patent protects the manufacture of a hollow airscrew which is divided longitudinally into two or more parts each of which is a stamping, pressing or forging of light alloy, the parts being united by synthetic rubber or resin. The dish-shaped sections are secured by a bonding-agent of synthetic rubber or resin. The edges of the parts are morticed or rebated to form a lateral and longitudinal interlock. The blade may be bound with wire or tape along whole or part of its length and the edges are grooved to position the wire. The thickness of the walls diminishes from root to tip, and the whole assembly is sheathed with synthetic rubber or resin. The bonding -agent and sheathing are conveniently converted isoprene and polymerized butadiene.

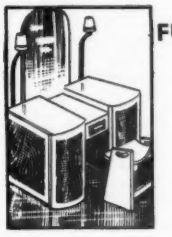


AGRICULTURE

Plastics from milk are referred to in a Bulletin just issued by the United States Department of Agriculture, Washington, D.C., U.S.A. Skim milk has long been used in making casein, for coating printing paper, for making plastics, and for use in paints and glues. The Bureau chemists have now developed a process by which a fibre having many of the characteristics of wool can be made from any acid casein of good quality, and they have dedicated their patents to the public. Casein fibre is not as strong as wool, but it has the same resiliency and takes the same dyes. It is not likely that it will become a competitor of wool, but rather that it may serve to extend the outlet for wool. By mixing casein fibre and wool it is possible to make fabrics having the desirable properties of wool, but at a lower price. When skim milk is used to make casein, whey is left as a by-product. This whey need no longer be wasted entirely, for it is possible to ferment it and recover a chemical called lactic acid. A few years ago the Bureau's chemists developed the fundamental information for making lactic acid, and commercial production of lactic acid from whey is now established in one large dairy plant. Now the Bureau is trying to find more uses for the lactic acid, or ways to make it at less cost from whey than is made from other sources. The cheaper grades of lactic acid, which contain some chemical impurities, are used in the tanning industry. One branch of the plastic industry uses a large quantity of an extremely pure grade, most of which has had to be imported because it was not available in America. Recently the Bureau chemists devised a method of making the purified grade so that it should no longer be necessary to import lactic acid. The Bureau has also made a large number of esters and other combinations of lactic acid, some of which may find applications in industry. The most notable success has been the preparation from lactic acid of a water-clear resin with remarkable elasticity and other properties which make it valuable for impregnating cloth, dressing leather, insulation, and probably many other uses which cannot be foreseen. This resin is now made by a synthetic process, but at a cost which limits its use. The lower cost of making it from lactic acid should encourage its wide use in various industries and thus greatly extend the market for lactic acid. **Wood plastics** are dealt with in an article on the "Chemical Utilization of Wood Wastes" in the September issue of *Pacific Chemical and Metallurgical Industries*. The idea of producing from waste wood a homogeneous mass that may be cast into any desired shape and serve as a substitute for wood itself is by no means new. By the use of suitable glues, binders and mineral cements, ground shavings and sawdust are moulded to make numerous articles, such as furniture ornaments, doll heads, novelties and tiles. However, plasticization of the wood substances into a homogeneous fibreless mass which will set and form a hard strong material without the aid of a binder is a much more difficult procedure. The natural lignin in the wood is considered to be a cementing and strengthening material for the tissues. The thought that these properties may be utilized for the preparation of plastics has led to the development of lignin plastics. Lignin will condense with phenols, amines, aldehydes and certain other organic compounds to form condensation products which are resinous. The

TMPLOYS PLASTICS

preparation and properties of these resins have been investigated by the Bureau of Chemistry and Soils, Washington, D.C., U.S.A., and by the Forest Products Laboratory, Madison, Wisconsin. Very interesting products are described, some of which are thermoplastic and form dark brown or lustrous black, hard, fairly strong resins. Some of these lignin resins, when dissolved in organic solvents, yield attractive wood stains. At the Forest Products Laboratory, Sherrard, Bateman and their associates have developed very promising lignin plastics by the partial hydrolysis of wood and hot moulding of the residue. They find it preferable to add 6 to 8 per cent. each of aniline and furfural. Digestion of wood under pressure in water and aniline also yields a material which may be moulded. A patent has very recently been assigned to the Masonite Corporation for producing a moulding composition from wood. The process is essentially one of hydrolysis, subjecting chipped wood to very high steam pressures and high temperatures for short periods of time. The resultant mass may be dried, ground and moulded or formed into thin sheets, which are then piled together and hot pressed. Black, hard products result. The company has built a semi-commercial plant for producing this material. At the Idaho School of Forestry investigations are proceeding regarding the problem of coalescence and plasticization of sawmill wastes. It has been found that ground sawdust and mill waste may be coalesced into hard dense products under proper conditions of temperature, pressure, moisture and other factors, without the addition of any chemical binders. Products have been made in this way which are stronger than the original wood. Coalesced pine wood has been made with a modulus of rupture of 862 kilograms per square centimetre, compared to 667 for the original wood. It has a specific gravity of 1.35 to 1.40. Removal of the natural resins causes a marked increase in the strength, indicating that surface forces are partly, if not mostly, responsible for the coalescence. Lignin-sulphur compounds have been successfully produced. Lignin combines with 1-2 per cent. sulphur to form a thermoplastic material that is hard, capable of taking a glossy polish, has a fair degree of elasticity (approximately 52,000 kilograms per square centimetre), and has a strength comparable to commercial plastics (modulus of rupture of 510-555 kilograms per square centimetre). Lignin containing large amounts of chemically combined sulphur (approximately 34 per cent.) is water soluble and readily stains wood. A considerable amount of interest is being taken in the possibilities of these wood plastics for use in aircraft construction and maybe some interesting developments in this field will take place in the near future.



FURNITURE

"Lauxite" adhesive resins, made by modifying urea resins with zinc chloride, are now being used for plywood manufacture in America. These resins have the following characteristics:—Available in a fine white, water-soluble powder. Solubility by weight. One part of resin dissolves very easily in the remarkably low amount of 0.3 to 0.7 part of water, usually 0.5 to 0.6. Thermosetting in about one-third the time of the phenolics or straight urea resins. Heat requirements very low (220 deg. F. is the usual temperature in plywood gluing). Water tolerances 3 to 7 per cent. moisture in the plies, as well as the water added with the glue to make a spreadable fluid. The resin is colourless and slightly acid and hence can neither stain wood nor show through thin plies. The dry bond is stronger than wood. On shear test the failure is usually wholly in the wood. Water and weather resistance very high as tested over a period of 20 months.

MISCELLANEOUS

A new shoe filler made of cork, latex and other materials is now being introduced by the General Tyre and Rubber Co., Wabash, Ind., U.S.A., for all popular types of men's, women's and children's shoes. The manufacturer has taken over the Gutwein patents and developments covering the new filler. The filler spreads easily in the shoe and forms a light, resilient cushion, which the manufacturer claims will not creep, bunch, crumble or permit gutter wells. It can be spread by hand with an ordinary putty knife, or, for faster output, a machine may be employed which spreads the filler quickly and evenly, levelling it off to form a smooth cushion for the outsole. Among the advantages claimed for the process are the elimination of predetermined sizes, shapes and materials necessary when sheet fillers are used. It is also claimed that the material may be adhered permanently to the seams and the inner and other soles, equally well to leather, rubber or composition, and that it is permanently flexible under all weather conditions. The porosity or "breathability" of the filler is also stressed by its sponsor. Marketed under the name "Corulyte," it is shipped in five-gallon containers and will not congeal in transit or storage. It is applied without heat and sets in a few minutes, requiring no change in customary production methods. **Antiseptics for rubber** articles, such as surgical gloves, hospital sheeting, bath mats, etc., are reported by Robert Engel, of Givaudan-Delawanna, Inc., New York, in an article, "Modern Antiseptics for the Rubber Industry," in the December, 1939, issue of *The Rubber Age*. The new materials are called Compounds G-4 and G-11 and are described as diphenyl methane derivatives. They are said to be odourless, sufficiently non-toxic so as to be perfectly safe to use on rubber goods, while possessing three to six times the bactericidal strength of thymol. "There are many interesting possible applications in the rubber industry for the new materials," says Mr. Engel. "Already antiseptic dress shields, toys and baby pants are being marketed. Use is also indicated in such products as hospital sheeting, surgical tubing, rubber gloves, hot-water bottles, nipples, adhesive plasters, rubber drain mats and sponges. Compound G-4," he reports, "has already been found effective as an 'athlete's foot' remedy in a 2 per cent. aqueous solution in alcohol. This is interesting in connection with all types of shoe linings and possible application is already under investigation by some of the large shoe manufacturing concerns. The spores of the pathogenic fungi, causing athlete's foot, can be prevented from growing on a lining treated with a sufficient amount of Compound G-4. In rubber floor mats, such as used in locker rooms, this should be a particularly desirable feature. The preparation of these various compounds to render them dispersible in latex is now under investigation, for many latex compounds will require the added antiseptic feature too." **Refrigerator cars** are now being made of cresol-formaldehyde-resin bonded plywood, according to *Refrigerating Engineering*, 38,320, Nov., 1939. The use of plastics reduced the number of individual pieces by 89 per cent.

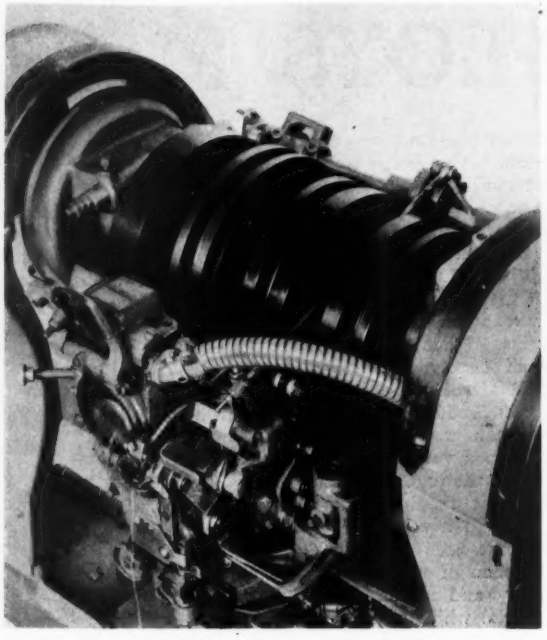
SHOE-STITCHING MACHINE WINS AWARD IN PLASTICS COMPETITION

A SHOE-STITCHING machine, outstanding in quality of performance and economy of operation, won for the United Shoe Machinery Corporation, of Beverley, Mass., a major award in the Industrial Moulded-Laminated group of the Fourth Annual " Modern Plastics " Competition, sponsored by *Modern Plastics* magazine.

Practical elimination of noise and vibration, reported reduction of 80 per cent. in total cam weight, 20 per cent. in cam installation cost and 50 per cent. in horse-power required, along with a possible increase of 100 per cent. in the speed of the machine, are but a few of the factors influencing the decision of the judges.

Responsible for much of this improved efficiency are the moulded-laminated Textolite cams, cam lever arms, shuttle, backing plate and accessory parts in the head of the machine, which are made by the Plastics Department of General Electric Co., Pittsfield, Mass.

This lightweight, strong and durable plastic material absorbs much of the shock incidental to stitching heavy leather, eliminates the wear and tear of metal to metal contact and reduces the necessity for constant lubrication. It makes possible a uniform structure in cam tract side walls, and the moulded tracks and core provide perfect balance. The resiliency of the material is said to permit an overload of 50 per cent. without distress.



This photograph shows the moulded-laminated Textolite cams, cam lever arms, shuttle, backing plate and accessory parts in the head of the shoe-stitching machine.

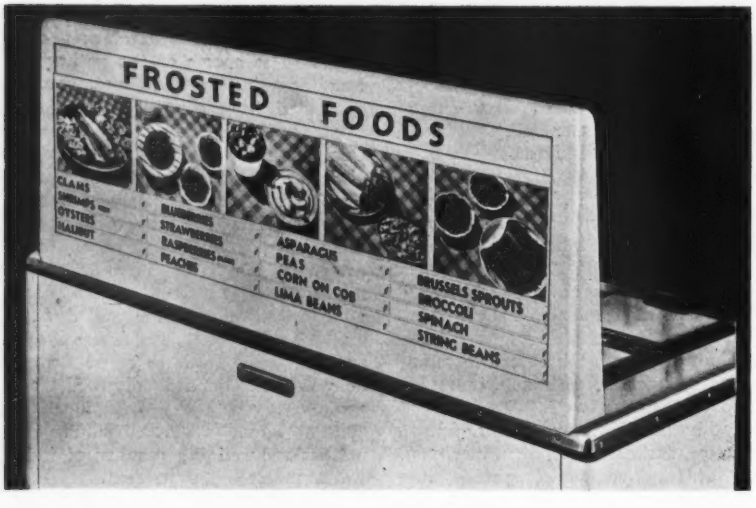
NEW PLASTIC DISPLAY

THE new Kelvinator frosted foods cabinet will make a strong bid for popular favour with a panel of illuminated, natural colour photographs of fruits and vegetables. These photographs are processed on rigid sheets of Monsanto plastic by a special colour-reproducing process developed by the Morgan Lithograph Co., of Cleveland, U.S.A. They capture perfectly the appetite-tempting appeal of frosted fresh fruits, vegetables, meats and fish.

There is no doubt that the development of this striking method of display will be watched with considerable interest by other food producers, particularly ice cream manufacturers. Natural colour photographs showing various kinds of ice cream dishes would surely tempt the public and play an active part in promoting sales. Such panels could be mounted in a similar way to that shown on the Kelvinator and thrown into dramatic relief by evenly diffused transmitted light.

The advantage of acetate sheets over glass is that they are more adaptable to colour-reproducing processes and the finished panels are not fragile or liable to damage in the same way as glass. As the retailer is provided with a spare set of these panels for replacing those fixed in position, it is important that they should not be cracked or damaged in any way during storage.

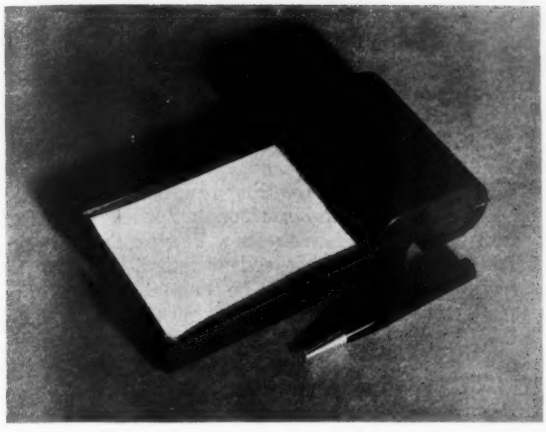
It is to be hoped that some enterprising English concern will develop the display possibilities of reproducing colour photographs on both acetate and celluloid films for shop window and counter attractions, especially the latter, which, when properly illuminated, can help to compensate for the necessarily restricted use of window lighting effects.

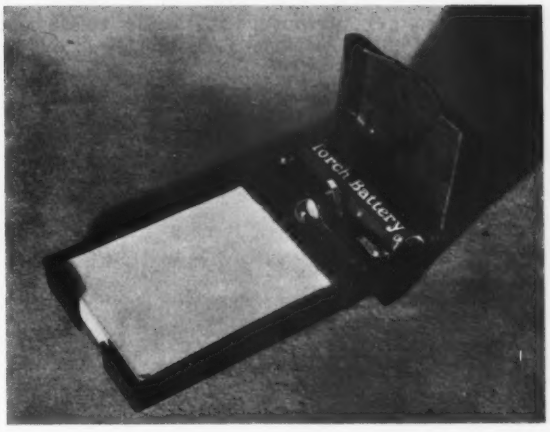


All the sales appeal of packaged frosted foods is captured in a series of illuminated natural colour photographs appearing on the new Kelvinator frosted foods cabinet, through the use of Monsanto plastics. These photographs, mounted in a panel on the front of the storage unit, show the frosted fruits and vegetables exactly as they will appear ready for serving. The photographs are printed by a special process developed by the Morgan Lithograph Corporation of Cleveland, on rigid sheets of Monsanto cellulose acetate plastic, and are illuminated from behind. The slides can be readily changed and include full colour illustrations of meats, vegetables and fish.

Ideas—

By the EDITOR





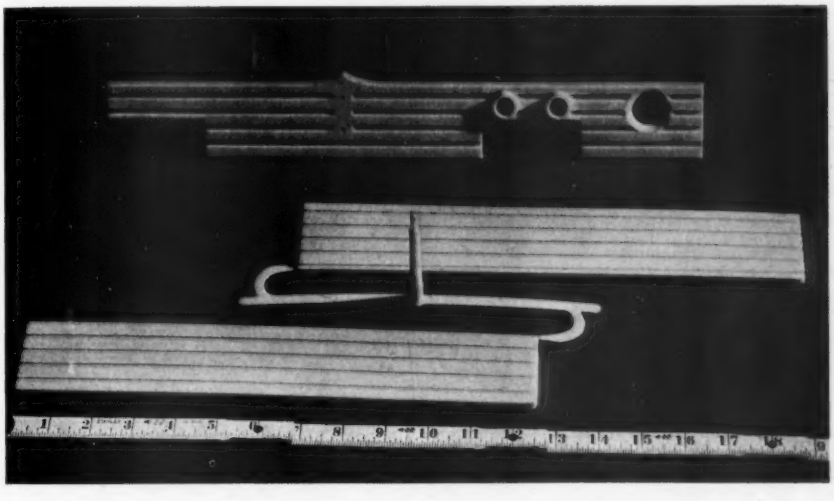
Lu in Tenebris

N.B. Mouldings, Ltd., have once again rung the bell with an exceedingly clever gadget. This time it is an illuminated A.R.P. writing pad, the first of its kind I have so far seen. As will be gathered from the photographs, the tiny lamp is ignited when the pencil is withdrawn by the release of a spring which completes the circuit. On replacing the pencil the lamp is extinguished. The orifice for the pencil is seen above on the under side of the pad.

The pad is not only ingenious in design, but is also extremely compact and simply constructed. I certainly hope and expect a big market for these in our A.R.P. shelters. Obviously, the pads should also be of great use to many travellers and canvassers who unfortunately try to pursue their lawful occasions under black-out conditions. Finally, it might be that the War Office may one day issue them to subalterns in the front line so that, during a heavy attack, the return of the number of writing pads, horse blankets and cycle tyres may be properly made out.

Injection Moulded Panels

In most industries, the replacement of metals by plastics is growing apace; but at the same time there is naturally increased competition in the plastics industry itself. Thus, in the motor industry, where the phenol-formaldehyde powder moulding and, to a smaller extent, the cast resin held the field, cellulose acetate is now making itself felt—and seen. Cellulose acetate has for some time now been employed in U.S.A. for such purposes, but has always been moulded by the compression process. More recently large pieces by the injection process have made their appearance. The Chrysler, for example, is now fitted with the injection moulded acetate panels shown in the accompanying photograph, from which it will be seen that two panels, each 12½ ins. by 2 ins., are made in one shot. They have been produced on a Reed-Prentice machine. Such large mouldings have never, I believe, been made in this country by injection and perhaps we shall have to wait until after the war for outlets in the motorcar industry. We are otherwise engaged for the next few years.

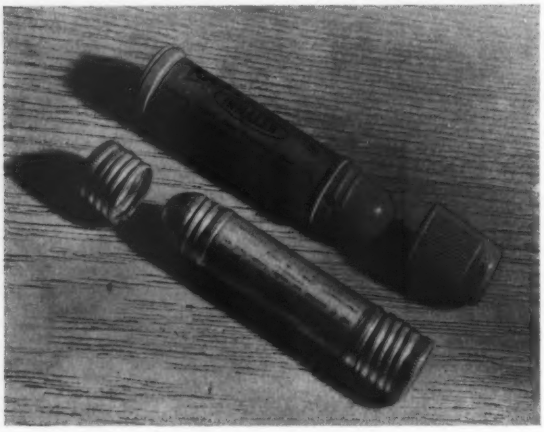


Cellulose acetate panels made by the injection process are being fitted on to the new Chrysler.

In passing, we understand that there are about 30 Reed-Prentice machines working hard in this country. Altogether the number of injection machines installed here must run into some hundreds.

Plastics v. Metals

Very rapidly I am getting information of the extent to which plastics are replacing metals in war-time. I think the plastics industry should combine in a very determined effort to blazon forth some of the replacements that have taken place and show the outside industrial world what can be done by our industry to help them in their hour of need. Certainly



I believe that this journal, with the help of several moulding concerns, is doing much to put this across.

The lower metal inhaler, made in aluminium in pre-war times, is extremely well known. Prestware, Ltd., is producing a new type in plastics, and to me it looks a much more pleasing and cleaner job of work. This is shown above the metal container.

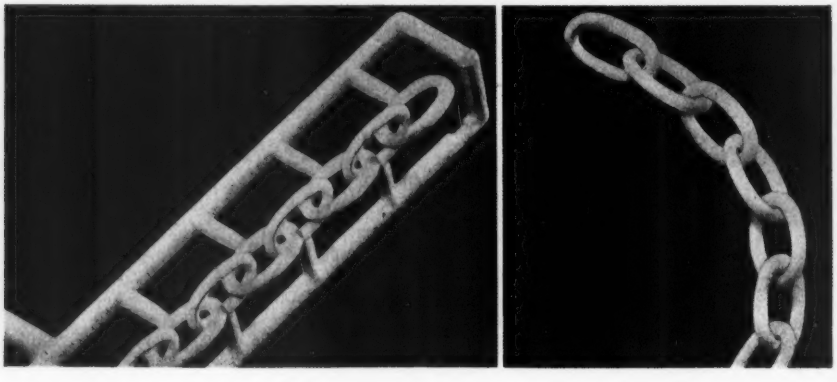
Idea—but not so Good

On occasion I read, for light refreshment, not only detective stories, but also a humorous compilation entitled "Parliamentary Debates—House of Commons' Official Report." In the issue of January 16 last there is a joke by one ingenious member, in the form of a question he put to Mr. Burgin. He asked the Minister of Supply "whether his attention had been drawn to the use of orange peel for the manufacture of acetone, of insulating material, plastics and medicines, as well as the conversion of the peel into a poison gas absorbent for gas masks, and whether an investigation of its possibilities in this direction has been made with a view to using them in the prosecution of the war." The danger of this type of joke is that there is some truth in the possibility of manufacture. Thus we suppose somebody who has looked up a book of chemical technology has discovered that orange peel is cellulosic in character and also that it is fermentable—hence a gold mine awaits somebody who will convert it into alcohol, acetone, etc., or purify the cellulose for celluloid manufacture, or, alternatively, utilize the dried peel as a filler for resin mouldings, and as a by-play make another fortune from the oil in the peel. These problems are best left to the huge orange-growing countries or orange-juice bottlers, who can afford to lose their money with such ideas. We shall still utilize cotton or wood or maize for making our plastics or acetone, instead of utilizing a horde of boy scouts, armed with pointed sticks, to pick up orange peel left behind by our citizens on Hampstead Heath or Epsom on Derby Day. Likewise, we shall still use coco-nut shell and other special materials, which are now being utilized in this country, for making an excellent activated carbon for our gas masks. It must not be thought we are jeering at the Member out of mere malice, but there are literally tens of thousands of similar processes which might equally be suggested from a knowledge of chemistry, but which have no foundation for production on an economic scale. As well suggest the manufacture of sugar by Professor Baly's process, merely because he produced some in a laboratory flask by the action of sunlight on formaldehyde. Besides, surely such questions should not be brought before Parliament, but put to the Inventions Committee we hear so much about. In passing, Mr. Cross, our Minister of Economic Warfare, didn't shine the other night on the radio when he gave us the remarkable information that Bakelite was made from milk.

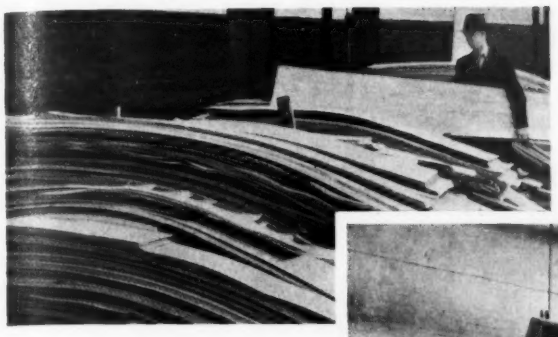
Handbag Chains

Most of those who visited the B.I.F. plastic section last year probably saw and examined a remarkable weldless chain of phenolic resin moulded, we believe, by Thos. de la Rue and Co., Ltd. It was used for some electrical insulating job and was duly admired by all. If I remember rightly, the links were about 2 ins. in length and about $\frac{3}{8}$ in. thick.

Here is another chain, this time made of a different material and by a different method. Tenite, the cellulose acetate made by the Tennessee Eastman Corporation, Tennessee, U.S.A., is being used to make handbag chains by the injection process, and, as will be seen from the photographs, the chain is weldless, and, of course, the usual operations of shaping, cutting, threading and cementing are all eliminated by the remarkable mould design. All that is necessary is to sever the links from the runners.

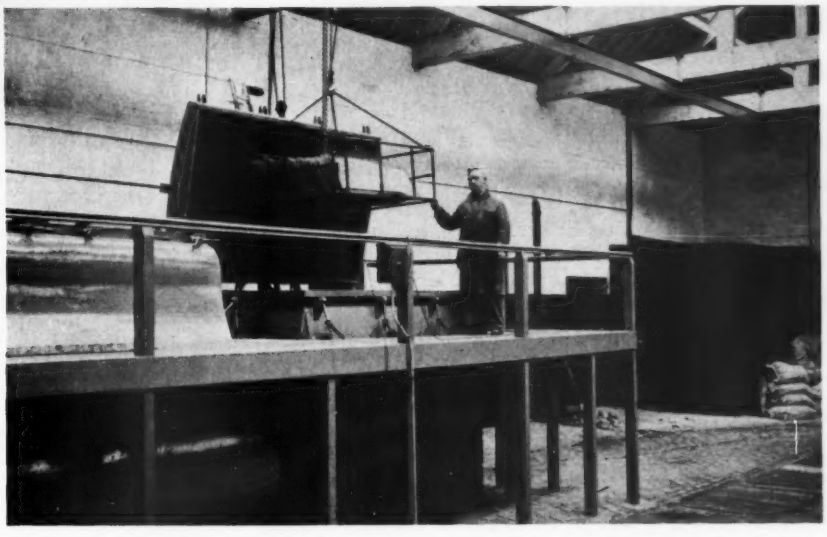


Weldless chains for handbags made from Tenite cellulose acetate by the injection process, utilizing an extremely ingenious mould.



PERMALI

Some notes on resin impregnation of wood and the production therefrom of constructional material for electrical and engineering purposes



Figs. 1 and 2.—Above, stocks of wood veneers and, on right, the impregnating vessels at the works of the New Insulation Co., Ltd., for the production of Permali.

WHEN Dr. Baekeland produced synthetic resins of the phenol formaldehyde type and so made a material to replace the natural resins, they were rapidly adopted, not only for the production of varnishes, but also in an industry that already utilized mixtures of natural resin and wood flour mixtures, a forerunner of the modern Bakelite moulding powder. These mixtures, after pressure treatment, were called "hardened-wood," but that this was a misnomer is now recognized. Wood flour bears very little relation, except chemically, to the original wood from which it is made, for when we talk of wood it must be the material with its physical structure retained. Thus, a synthetic resin moulding made from a powder containing 50 per cent. synthetic resin and 50 per cent. wood flour is not a material made of wood bound with synthetic resin. It is of synthetic resin with additional properties given to it by utilizing wood flour as a filler. It is important to keep this rather simple explanation in mind.

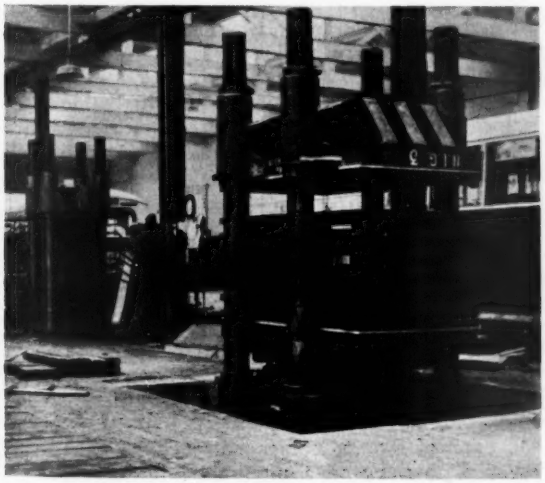


Fig. 3.—The Press Shop; in foreground, 1,200-ton 7-daylight press.

In more recent years it has been the knowledge that wood itself is such an admirable material for constructional work that scientists have sought to retain the fibrous structure that gives it its great strength and yet further enhances its properties by impregnation.

Thus the electrical industry had taken early steps to try and achieve this object by impregnating wood with paraffin wax, linseed oil, etc., but such materials had their drawbacks, for under conditions of heat and stress the impregnated medium is displaced and the wood begins to breathe, absorbing air and moisture. A well-known example is to be found in the insulating parts of oil-circuit breakers, which, if treated with an impregnating material not permanently fixed, absorbs moisture from the oil and deteriorates as an insulator.

A second stage of wood treatment has been the approach to the perfect seasoning of wood by natural or artificial means in order to remove instability, but so far no method has proved really successful.

With the advent of synthetic resins, their use as an impregnating medium for wood was soon suggested, since they would at once impart important properties to the material which it did not already possess—the desired stabilizing of unstable gums, water resistance, high dielectric strength, resistance to many chemicals.

Such a procedure is, of course, very different from the moulding powder idea, first because the resultant material is not mouldable in the sense that mixtures of resin and wood flour are mouldable, and secondly because it is not a synthetic resin strengthened by a filler, but a wood densified with synthetic resin.

Early attempts to impregnate wood with synthetic resin included experiments on very thick pieces of wood, but it was soon discovered that the difficulty of

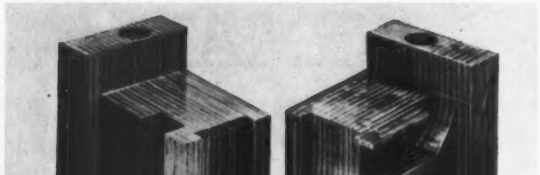


Fig. 4.—End winding support for Short Circuit Test Generator.

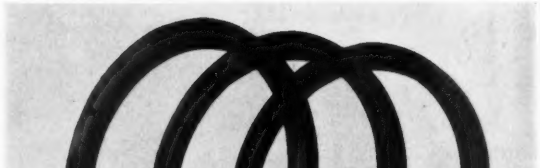


Fig. 5.—Exploded view of Transformer End Ring. (Total thickness 10 ins.)

removing moisture or, rather, of controlling the moisture content, and the difficulty of impregnating them evenly was so great as to preclude this method.

It must also be remembered that all woods cannot be impregnated with resin efficiently. Unlike creosote, many of the synthetic resins are not compatible with the natural resins contained in some woods.

It can be safely assumed that all wood impregnation is now carried out on thin veneers, which are then compressed together.

One of the earliest team of workers in this field was the French concern, Le Bois Bakelisé, who, in 1928, produced a material that soon found favour in electrical and engineering fields under the name of Permali. It is with considerable pleasure then that the following notes deal with the work of a new British firm associated with this French concern—The New Insulation Co., Ltd., of Gloucester.

We have on various occasions described the general principles of wood-veneer treatment with synthetic resin and the work of other existing concerns in similar fields. Some merely spread a solution on a roller or utilize a synthetic resin film glue. The process as carried out by The New Insulation Co., Ltd., differs, however, in certain important ways, which are worthy of comment. Up to the present time this concern has dealt mainly with the production of structures for electrical purposes, but we presume and hope that, following French practice, New Insulation Co., Ltd., will enter other fields, such as the chemical industry.

The raw materials are generally beech and birch wood in veneer form, varying from 14/1,000 of an inch upwards. Acacia is also employed for special purposes. After a preliminary seasoning the wood is processed under heat in a press to remove "free" water. A large number of these dried veneers are then loaded into a metal cage for treatment in the impregnation chambers, one of which is shown in Fig. 2, and where alternative vacuum and pressure can be exerted.

When the chamber is filled with several of such cages, vacuum is turned on to complete the removal of any free moisture retained in the wood, and also of low boiling volatile material present in the natural gums. When these have been removed, the synthetic resin (cresol formaldehyde) in the form of a solution in alcohol is introduced into the same vessels and vacuum is changed to pressure.

When the veneers have been thoroughly impregnated they are removed to a second adjacent chamber, where, under heat and vacuum, all the solvent is removed, leaving behind an even combination of wood fibre and synthetic resin.

The Pressing of Impregnated Veneers

On removal from the distillation chamber the veneers are packed ready for the pressing operations. Compression in the pressing operation is generally 30 per cent. or more.

The number of veneers for a definite thickness is packed into each of the platens of the presses, two of which are shown in Fig. 3. The foremost is a 7-daylight press of 1,200 tons, each platen being independently heated and cooled. Very great care is needed in regulating the correct incidence of temperature and pressure to take into account the rate of heat transmission through the mass to ensure uniformity of compression and polymerization of the resin. Sealed recording pressure gauges and temperature recording instruments are fitted to each press to guarantee repetition of exact conditions. We were interested to note, too, the number of Fraser Radial Pumps employed with complete satisfaction on these presses.

Usually the veneers are formed into sheets without supports for the edges, but when thicknesses above normal are required (10 ins. and upwards are commonly achieved), side supports are used and the pressing process becomes in fact a moulding process. In the production of very thick blocks recourse is often made to embedded thermo-couples to ensure polymerization of the resin throughout.

The finished material has the appearance of an extremely dense plywood. It is some four to six times harder than ordinary hardwoods, such as beech and oak. Its specific gravity is about 1.3 to 1.4.

The bulk of the production is sold in the form of electrical components, machined from the thick board or block. The machine shop in the works has been especially developed for this class of work, entailing, as it does, a special technique and range of tools for working resin-bonded material. The use of specially equipped saws, planing machines and vertical spindle tools enables a very exact and economical production to be organized. An interesting development is the use of an overhand spindle tool calibrated as a jig borer for the mass production of repetition parts to close limits. Parallel and profile turning is done on specially developed lathes designed to run at headstock speeds of 3,000 r.p.m. or more. Of special interest here is the production of screwed components of all diameters to very fine accuracy on a multi-point thread miller at cutting speeds of over 7,000 ft. per minute.

Forms of Permali

In view of the fact that Permali, like ordinary plywood, is made up from a number of veneers, it is produced in several forms depending on two variables, namely, the thickness of the laminæ and the direction of the grain in the various laminæ. Generally speaking, the principle applied is that material in which the grains of alternate laminæ are running parallel is used for parts subject to a tensile strain or which act as a loaded beam; material with the grains of alternate laminæ running at right angles to one another is used where rigidity is required in both directions. This latter material is also the strongest for resisting compression through its thickness. An average compressive strength figure for this type is about 30,000 lb./sq. in. A modification of these forms, with the grain of succeeding laminæ still at right angles to one another but with all the grain disposed at 45 degrees to the main axis gives the best results from the point of view of the dielectric strength along or across the laminæ.

There is also a type used for building up composite parts, such as transformer end rings. These are constructed from segments so cut that their grain is substantially parallel to the tangent of the part. This type is well illustrated in Fig. 5.

We have thus in Permali a raw material possessing very valuable properties, of which great dielectric strength, mechanical strength and high resistance to acids and alkalis are prominent.

As pointed out previously, most of the finished components made at the Gloucester works are for the electrical industry, consisting of end winding supports for generators, circuit breaker tension rods, terminal boards, end rings for transformers, bus bar supports, bolts and nuts, and a hundred other electrical construction units. One of the most important applications is that of insulating fish-plates for railway signalling. There are now many track-circuit block joints in use in this country, replacing the old type of steel wrapped with fibre or the complicated divided plate with fibre separation. The great mechanical strength, resistance to adverse weather conditions and to continual shock, added to high electrical efficiency, make Permali particularly suitable for the purpose. It is stated that over 60,000 of these joints are used on French railways.

Obviously, too, the properties of Permali make possible a great field in the industrial engineering world, other than electrical engineering, and in many respects follow the lines taken in industry by paper and fabric laminated materials. Silent gear wheels, bearing and pulley wheels and water-lubricated hydraulic bearings are manufactured. Acid-resisting vessels for acid storage and agitators for mixing acidic liquids are indicated as being outlets for Permali, while

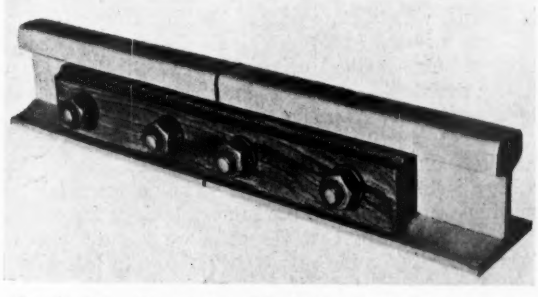


Fig. 6.—Permali insulating fish-plates are in extensive use here and on the Continent.

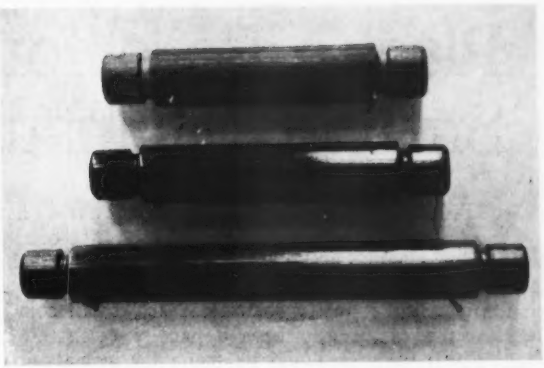


Fig. 7.—Circuit breaker tension rods machined from Permali.

drying frames, yarn supports and dyeing vessels are already in use in the textile industry as being not only acid resisting, but also because it does not change the colour of the dye.

An example of fine construction of very large vessels is seen in Fig. 8, which shows a mixing mortar for dynamite made throughout in Permali. For such purposes all metal parts must be rigorously excluded. Finally, in view of its strength and low specific gravity, Permali lends itself admirably to the construction of aircraft, both for frames and for air-screw blades.

Bakelized Paper Tubes

Permali and similar resin impregnated and laminated boards cannot be formed into tubes, but since tubular insulations made from paper are an important adjunct to many Permali components, such manufacture is an important part of the works, where several paper impregnating and tube rolling machines are installed. A similar technique is adopted for the winding of bushings made from resin-impregnated paper, and such components of the condenser type for voltages up to 33,000 are in constant production. These are primarily switchgear parts and, apart from the orifice type, are usually wound direct on to the conductor or on to a tube through which the conductor passes.

In conclusion, we beg to extend our thanks to Mr. A. A. Heath, managing director of New Insulation Co., Ltd., for permission to view the factory and its working.

Fig. 8.—An interesting industrial use—a mortar for mixing dynamite made throughout of Permali.

Plastic Foils for Small Coil Insulation

By E. E. HALLS

WITH most products of engineering there has existed, as a rule, a relatively wide range of raw materials from which selection could be made for the manufacture of the components. In the case of what in the electrical industry are classed as "small coils" there has until recently been a paucity of materials from which selection could be made for insulation.

"Small coils" comprise cores of relatively high permeability which are enveloped with one or more windings. They are mechanisms for controlling electrical energy designed in such a manner that any electrical input within a certain range will yield a predetermined output of electrical or mechanical energy. As relay, transformer, retard or induction coils, they find application in practically every phase of life, in communications by telephony or radio, signalling systems, domestic appliances, power transmission, plant and machinery operation, and illumination control.

Coil insulation has always presented a problem of difficult satisfactory solution. High-grade papers and fabrics have formed the basis, and the numerous changes occurring to the forms of these employed during the last 20 years emphasize both the intense attention focused on the finding of the most suitable material and the failure to obtain satisfaction with these base materials. Plain papers or fabrics with a final wax or varnish impregnation of the coil; waxed or bitumenized paper or fabric; varnished or lacquered papers and fabrics: all have been exploited with indifferent results. Simultaneous experimentation with the wire coverings, viz., cotton, silk or enamelled covered conductors, or textile and enamelled insulation, have also failed to yield the desired result. The fundamental trouble of electrolytic corrosion due to a combination of influences, viz., ionizable chemicals retained by paper or textile, moisture absorption by these materials and moisture condensation from fluctuating temperatures, has not been eliminated by work along any of the lines above mentioned. The rational solution is to employ insulating materials which, unlike paper and textiles, do not contain ionizable chemicals and which are not highly absorptive of moisture. Surprising as it may seem at first sight, the synthetic plastic foils fulfil this role so closely that design in the future will tend largely to incorporate these materials in such a manner that their unfavourable initial cost can be mitigated.

The plastic foils available are three in number, viz., cellulose acetate, polystyrene, and vinyl chloride type. The first of these has been available for some years in a wide range of thicknesses and widths, as well as in different colours. The polystyrene film is of more recent development, but being at the present time more expensive, it has therefore been considered to a lesser extent; as a matter of fact, its rather special electrical characteristics give it claims in another electrical field, viz., fixed condensers. The vinyl chloride product is also more recent and more expensive, but its availability is noteworthy because it signifies that shortly another member will undoubtedly be in the field in a competitive sense with cellulose acetate. The main discussion in this article will therefore be confined to cellulose acetate.

If the coil core is the solid metal type, the insulation is generally applied over the metal core. This can be done by several turns of foil of width slightly in excess of the winding space so that it extends up the cheeks a little, or by means of a tape spirally wound with overlap. A cellulose acetate dope quickly applied and rapid in drying can be used for anchorage. The tape method offers an advantage in minimizing the effect of shrinkage of the acetate in service under prolonged dry, warm conditions. In both cases the lappings can be sufficient to safeguard against puncture at slight prominences in the metal core. A strong feature of acetate in this application is that it can be obtained in such thin gauges that even when multi lapping is necessary the overall thickness is considerably less than when paper or textile is employed. Thus winding space is conserved. Material thicknesses from 0.001 in. to 0.003 in. are used in this application. Cheek washers are formed by the usual type of blanking tools. They are 0.005 in. to 0.007 in. thick and are of the split type for easy fitting into position. Where desired, they can be formed instead of flat, an inner lip being provided to nestle over the core.

Where two or more windings are applied on the same core the insulation between windings comprises two layers plus a small overlap of cellulose acetate foil of thickness chosen from the range 0.001 in. to 0.003 in. Or again, the spirally applied tape may be used. Joints soldered at breaks in the winding, or at connections to leads-out, are covered by a folded acetate slip.

The outer covering of the coil may be one for protection against mechanical damage and for neatness, or may additionally be a lapping to separate a lead taken across the winding from the winding itself. For the latter purpose the same material as the interleaving is used. For the former, the lapped tape is employed, or two turns plus lap of a rather thicker material, generally 0.005 in. This can be coloured to mask the winding or to satisfy any colour code required.

Coils insulated between every layer in the winding by means of 0.0005 in. or 0.001 in. acetate film automatically fed in from the coil winding machine are easily manufactured. The cores are generally inserted after winding the coils. The latter are bank wound on a common mandrel; the latter is first covered with a number of laps of acetate foil, the number and thickness being determined by the wall thickness of former desired. The coils are wound in exactly the same way as paper interleaved coils would be, and finally finished off with several layers of the interleaving material. This is secured with acetate dope. The bank is slid off the winding mandrel and the individual coils separated by sawing. One method of treatment of these coils is to flatten the surplus acetate at the ends and partially seal, by pressing on hot plates, and then fixing appropriate end washers with acetone. They then form easily handled units for assembling on to cores. Another procedure is to tape with acetate strip on torroidal-type machines and finally to dip in acetate dope for sealing.

It will be noted that the cellulose acetate used for insulation all falls in the category of film or foil. Thicknesses employed range from 0.001 in. to 0.010 in., and they can be obtained in pad form in continuous lengths of any desired width to suit specific applications. The

Table No. 1.—Bursting Strength Values of Foils Before and After Ageing.

Material	Test Conditions	Period Weeks	Bursting Strength, Ashcroft, lb./sq. in.		
			Min.	Max.	Mean
0.001" Colourless Cellulose Acetate	As received	—	23	30	26
	Dry heat	1	23	33	29
	Dry heat	4	22	32	29
	Dry heat	12	23	27	26
	Water immersion	1	22	31	26
	Water immersion	4	25	32	29
	Water immersion	12	20	31	26
	Humidity	1	25	34	29
	Humidity	4	24	28	24
	Humidity	12	23	30	26
0.0035" Black Cellulose Acetate	As received	—	35	52	46
	Dry heat	1	40	50	44
	Dry heat	4	42	53	49
	Dry heat	12	53	58	56
	Water immersion	1	39	56	46
	Water immersion	4	38	48	43
	Water immersion	12	44	52	48
	Humidity	1	45	54	50
	Humidity	4	48	60	54
	Humidity	12	53	57	55
0.0015" Amber Polyvinyl	As received	—	Too elastic to burst by Ashcroft		
	Dry heat	1	39	49	40
		4	32	51	42
		12	38	48	43
	Water immersion	1	Too elastic to burst by Ashcroft		
		4			
		12			
	Humidity	1			
		4			
		12			

Table No. 2.—Dimensional Stability of Plastic Foils Under Accelerated Conditions Tests.

Material	Test Conditions	Period Weeks	Percentage Change in Dimensions		
			Length	Width	Thickness
0.001" Colourless Cellulose Acetate	Dry heat	1	nil	nil	nil
		12	nil	nil	nil
0.035" Black Cellulose Acetate	Dry heat	1	nil	−0.5	+3.0
		12	−2.0	−1.0	+6.0
0.0015" Amber Polyvinyl	Dry heat	1	nil	−0.5	nil
		12	nil	−1.0	+13.0
0.005" Colourless Polystyrol	Dry heat	1	nil	nil	nil
		12	−1.0	−0.5	−1.0
0.001" Colourless Cellulose Acetate	Water immersion	1	nil	nil	nil
		12	−1.0	−1.0	nil
0.0035" Black Cellulose Acetate	Water immersion	1	−3.0	−2.0	nil
		12	−3.5	−2.6	nil
0.0015" Amber Polyvinyl	Water immersion	1	nil	nil	−13.0
		12	nil	nil	+ 6.6
0.005" Colourless Polystyrol	Water immersion	1	nil	nil	nil
		12	nil	nil	nil
0.001" Colourless Cellulose Acetate	Humidity	1	−0.5	nil	nil
		12	−1.0	−1.0	+18.0
0.0035" Black Cellulose Acetate	Humidity	1	−0.5	nil	nil
		12	−3.0	−2.7	+5.5
0.0015" Amber Polyvinyl	Humidity	1	nil	nil	nil
		12	−0.5	−1.0	+13.5
0.005" Colourless Polystyrol	Humidity	1	nil	nil	nil
		12	nil	nil	+0.5

special characteristics of cellulose acetate are strength and resistance to corrosion. As to the former, tensile qualities are at least equal to the papers and textile formerly employed and bursting qualities are exceptionally high in relation to thickness. Some values on material before and after ageing are given in Table No. 1. Good bursting strength is of particular value in coil winding, reflecting ability to cover uneven winding and to turn-up at cheeks without fracture. Corrosiveness, too, is a vital feature in small coils, probably the majority of failures in service resulting from electrolysis through the insulation under D.C. potentials. In the class of coil in question, the wire comprising the winding is insulated with its own enamel covering which is not in itself a perfect continuous film. Some pinholes exist in it, as well as defective areas due to mechanical damage in winding, and electrical leakage is possible from such defective points. When service voltage conditions are particularly severe, inter-layer insulation material must possess high insulation resistance and retain this under damp conditions; it must be free from ionizable chemicals or directly corrosive chemicals. Cellulose acetate possesses all these characteristics; treated papers and textiles fail in all of them. When less severe service conditions are imposed, interleaving between windings and, of course, insulation of the core are employed. Even so, it frequently occurs that the full voltage drop may be between the inner end of the winding and the core, or between the adjacent ends of the two windings. Therefore, similar discrimination for the insulation is required, particularly with respect to quality in the thickness direction. Compared with papers and textiles, treated or untreated, cellulose acetate is a stable compound, free from retained chemicals or ionizable materials, and its water absorption is negligible. From these points of view, polyvinyl and polystyrene films resemble the acetate.

In the above the plastic foils have been depicted as the ideal coil insulation, but there are other features to be considered prior to ultimate selection. The two of importance are dimensional stability under varying service conditions, and permanency of characteristics under these conditions. Dimensional stability is of importance in length or width, because of the possibility, if shrinkage occurs, of the winding making contact with the core at the cheeks, or with adjacent windings. Similarly, covers employed for mechanical protection of the winding must not exhibit a tendency to shrink away from cheeks and thus expose the winding, or to expand and become unsightly. Permanency in service is essential, as most of the coils involved have to provide long service life. Deterioration of the insulating material means failure of the insulation, and therefore of the coil. Unfortunately, some plastics do change their characteristics with age, generally due to loss of, or change in, the plasticizing agents. The extent to which the acetates suffer in this direction is relatively small.

The simple tests adopted by electrical testing laboratories for checking stability and permanence because they are capable of being easily conducted in any laboratory are threefold, viz.:—

(a) Prolonged exposure to dry heat at 60 degrees C.
(b) Immersion in water at ordinary temperatures.
(c) Prolonged subjection to cycles of hot and cold humidity, the hot period (50/55 degrees C.) conveniently corresponding to the working day, and the cold period (atmospheric temperature) being overnight; with liquid water present, 100 per cent. humidity is secured in the latter portion of the cycle.

Typical specimens examined under these conditions are detailed in Table No. 2. This is self-explanatory. It will be noted that major improvement occurs in the thickness direction, in which it is unimportant. Also, the bursting strength data given in Table No. 1 do not indicate any serious physical deterioration due to ageing of cellulose acetate, and although the change in polyvinyl is quite marked, the material remains sound.

Thus, electrically, chemically and mechanically, cellulose acetate is a sound material for small coil insulation, while the polyvinyl and polystyrol foils are plastics which may develop to provide suitable alternatives.

PRODUCTION

Practical Information dealing with Raw Materials, Moulding and Forming of all types of Plastics—Thermo-Hardening and Thermo-Plastic—Works-Organization, New Plant and Control Apparatus

NOTES AND COMMENTS

The Ford Works and Soya Beans

ON previous occasions we have referred to the research work on soya bean plastics and, indeed, their actual use in automobile manufacture by the Ford works in Dearborn. Unfortunately the information has been very sparse. All that we knew, in fact, was that the plastic was not composed of soya bean alone, but was mixed in some form or other with phenol-formaldehyde resin.

The veil has now been lifted—however slightly—with the publication of an interesting article in *Modern Plastics*. It is very definite that the plastic is utilized in large quantities, judging especially from the statement that distributor and coil cases, accelerator pedals and tractor seats are being thus made. Trunk compartment doors are made on a 1,200-ton press, but it is not quite clear whether this is of the new soya bean plastic or some other thermo-setting resin.

As for the manufacture of the raw material, details are lacking, unfortunately. Oil is removed from the bean by solvent extraction, leaving a protein meal. With the addition to this of phenol and formaldehyde, a protein-phenol-formaldehyde product results.

Much of the research work on soya bean phenol-formaldehyde plastics was carried out at the Regional Soya Bean Industrial Products Laboratory of the University of Illinois, which body, no doubt, will issue scientific bulletins on the subject.

Fords are, of course, using all types of plastics and methods. The photograph in *Modern Plastics*, showing injection moulding machines being fed with powder by gravity feed pipes from a balcony floor, is an eye-opener.

Get Out Your Scrap Iron

THERE is now taking place a nation-wide iron and steel scrap campaign to enlarge the supplies of these metals to the steel works, foundries and blast furnaces. Already some 150,000 individual firms have been approached and as a result additional scrap has been secured that would have taken ten or a dozen ships to bring to our shores if it had had to be imported. The importance of this will be realized when it is remembered that in 1913 the tonnage on the U.K. Register was 5,017 ships of 16,576,000 total tonnage as against 3,325 of 13,952,000 tonnage in 1938.

The very success of this experiment has convinced those charged with the control of the manufacture and distribution of iron and steel in this country that an intensification and extension of this effort will lead to still more solid results.

The plastics industry, even down to the smallest works, can help by a careful examination of their scrap material. There are always helpful quantities of old metal about in odd corners, whether old gates and railings, discarded tools and moulds, shovels, pails, chains and so on, which constant use or the march of time have caused to be thrown aside. All these are wanted urgently.

Safety First

WAR is responsible, we know, for a great many misfortunes, not the least of them occurring in the Home Front. Those who took part in manufacture during the War to End Wars No. 1 had many stories to tell in after life of the sharp rise in the accident curves and the appalling increase in industrial wastes of all types.

In a recent letter to the Press, Lord McGowan said: ". . . It is therefore extremely important that every kind of wastage should be avoided and that there should be the greatest possible conservation of resources. In war-time, when the urgency of production is the primary goal, there is a tendency to overlook many forms of industrial waste and, above all, the most alarming form of industrial waste—accidents. The disorganization which results from an accident in the works retards production and renders impotent, even if only temporarily, valuable man power. It is therefore more than ever necessary to take all possible measures to prevent accidents."

The present war is far worse than the last for the manufacturer. The black-out system is a peculiar and special curse in the works and has already been the cause of many grey hairs in the works manager's head. The greatest danger is that produced by insufficient or unwonted lighting in which the hand, foot and brain are not well co-ordinated. The eye receives curious light effects or is insensitive to others in this strange troglodyte life. The danger to life and limb is of paramount importance, but so, too, can there be strange economic losses.

We all know, too, now, the dangers of working three shifts, and of how in the early hours reaction is at its lowest ebb. With all the best will in the world on the part of workers, carelessness creeps in, quality declines, as does inspection and control, and with the added danger of poor lighting, accidents are more numerous. More than ever we must "watch our step."

Inquiries and Answers

(In Which is Included General Correspondence)

Moulded Plaques

Mr. Brian Hills's statement regarding the minimum age of the plaque he sent us has been completely confirmed by a letter from M. Forres, of the large French moulding concern, M.I.O.M. We are very grateful to M. Forres for the considerable trouble he has taken to settle the dispute and for writing at such length on this very interesting subject.

M. Forres has also enclosed an abstract from the old treatise he mentions. It is indeed surprising that the early efforts of wood moulding can be traced back so far.

Vitry-sur-Seine.

The Editor, *Plastics*.

Dear Sir,—I beg to acknowledge receipt of your letter of December 19 which gave me an opportunity for looking further into the matter of "bois durci."

When I wrote you that the plaques published in your June issue were manufactured by our firm about the year 1910 I was guessing that date from an old catalogue of our firm, published about that time, which is still in my possession and which shows these plaques as well as other articles made from "bois durci."

Upon consulting in our library an old treatise of the art of moulding, the "Nouveau Manuel Complet du Mouleur," by Lebrun and Magnier, republished in 1917, I found, however, that the invention of "bois durci" goes back to the year 1855, when the inventors, Lepage and Talrich, got a French patent on that subject. Later, a certain M. Latry bought these patent rights and went ahead with the manufacturing and selling side of the problem. I am enclosing a copy of the French text to which I am referring.

One of our former directors told me recently that our firm, founded in 1898, bought the business of M. Latry between 1898 and 1901. The moulding of "bois durci"—with the old moulds taken over from M. Latry—went on until about 1907 or 1908, when the blood-wood flour mixtures were gradually replaced by mixtures of natural resins and wood flour and, later, by synthetic resins and wood flour, although the old trade-mark "bois durci" was still applied to these mouldings of a different composition. During the War 1914-1918, similar plaques—showing Joffre, Foch, etc.—were moulded by compressing ordinary wood flour, without any addition, in blue-hot steel moulds. After 1920 these artistic mouldings disappeared entirely from our catalogues.

The chief outlet for mouldings in "bois durci" were plaques and ornaments for the furniture trade and especially for pianos, artistic ink-stands and ash-trays, etc.

The Beethoven series included similar plaques of Rossini, Meyerbeer, Gluck, Handel, Mendelssohn, Auber, Wagner, Mozart, Haydn, etc.

In view of these facts, your correspondent may be quite right if he claims that his Beethoven plaques date back to 1894 or earlier. It may come from M. Latry's workshop and one of his parents may have brought it back to England as a souvenir from one of the Paris "Expositions Universelles."

I am told that, among the old moulds taken over from M. Latry there exists still one representing a rather young Queen Victoria—it seems that the corresponding plaques were on sale at the "Exposition Universelle" of the year 1867. But I have no time just now—for obvious reasons— to find out if this mould is still there.

FORRES,
Manufacture d'Isolants et Objects Moulés.

The following is the abstract enclosed by M. Forres:—

Bois Durci.
(Hardened Wood.)

Abstract from the *New and Complete Moulders Manual*, by Lebrun and Magnier (Paris, 1917, p. 275).

In 1823 a Parisian woodworker presented to the *Société d'encouragement* a specimen of furniture moulded from different coloured samples of saw-dust made into a paste with a tenacious glue. When the paste had hardened the piece of furniture could be varnished. The Society received this discovery favourably and the inventor was rewarded with a sum of money by the Government. The invention was apparently abandoned soon after.

A few years later, M. Sabastian Lenormand put forward a method of obtaining ornaments in relief from sawdust. The mixture, composed of fish-glue, "Flanders" glue and powdered wood, was run into moulds while in a pasty condition. The mouldings, however, were crudely made and far from strong.

It was not until 1855 that MM. Lepage and Talrich had the idea of making moulded objects with saw-dust and blood albumen, but although the principle had been discovered, the industrial application remained unsuccessful.

M. Latry bought the Lepage and Talrich patent and it was only after new research, especially regarding the methods of working the material and the type of mechanism, that he was able to create the industry, which has been carried to such a high degree of perfection. We pass over those preliminary difficulties which faced M. Latry—they were principally difficulties in the manner of heating and imperfection of moulds. To-day, the process adopted is as follows:—

"Wood flour, especially that made from rose-wood, is reduced to a fine powder and moistened with a quantity of blood mixed with water and dried in a stove at 50 to 60 degrees C. The moulding is made in rings containing polished steel matrices to reproduce with the greatest fidelity various artistic creations. The dried powder is piled into the moulds in such quantity that there is no excess on compression—that is, there is no 'flash.' [Editor: the French word used here is rather amusing—*bavure* = slobbering.]

"The pressure is obtained by means of a hydraulic press of high power.

"The plaques are gas-heated in such a manner that the heat is maintained constant during the entire operation.

"The moulds in their rings move in guides, so that no lateral movement is possible. During compression a stop fixes the distance travelled.

"The heating plaques are each furnished with separate gas supply, which moves with the movement

of the plaque, following the pressure given to the different rings. Each gas tube is 'doubled'—that is, provided with a concentric tube leading in cold air. The annular space between the two carries the gas.

"The heating by gas is costly, but is recompensed by the excellent results."

[EDITOR'S NOTE.—Historically, the above notes give valuable information, for the technique does not differ materially from modern practice. The use of rose-wood flour in preference is especially interesting and, we presume, is no longer used. It seems sad that this manufacture is no longer carried out by M.I.O.M., for the mouldings were obviously of high artistic merit and of great strength.]

Flash-lamp Cases

Liverpool, 20.

The Editor, *Plastics*.

Dear Sir,—Please can you assist me with the address, or addresses, of plastic manufacturers who may be interested in the production of a new type pocket flash-lamp case, upon which I have obtained a provisional patent? Little metal used in construction.

C. W. KENT.

[EDITOR'S NOTE.—The inquirer, as well as other readers, should remember that, generally speaking, moulding concerns are not interested in sales development. They merely mould to the order of outside agents, distributors, manufacturers, etc., who possess their own sales organizations. This must be so, unless the moulders mould very special products for, say, one industry; normally, moulding factories turn out mouldings for a hundred different demands. On the other hand, some of the moulders named in our Directory could put the inquirer in touch with distributors or agents.]

Luminous Pigments

28, Victoria Street,
London, S.W.1.

The Editor, *Plastics*.

Dear Sir,—Our attention has been called to the paragraph on luminous pigment appearing in a recent issue of your publication.

It may interest your readers to know that the British Standards Institution just before Christmas published a British Standard for Fluorescent and Phosphorescent Paints in its series of B.S./A.R.P. Specifications, a copy of which is enclosed.

We should be grateful if you would give this specification publicity, in view of the reference at the end of the paragraph referred to.

P. GOOD,
Deputy Director, British Standards Institution.

[EDITOR'S NOTE.—In the paragraph referred to in *Plastics* we stated: ". . . no standardization of all makes is possible. At such short notice it is quite impossible for bodies such as the British Standards Association or the Paint Federation to do much." We must therefore congratulate the B.S.I. for being very much "up to scratch."

The copy of the Specification is numbered B.S./A.R.P.18, and can be obtained from the offices of the Institution at 28, Victoria Street, London, S.W.1, price 6d., post free 8d. It deals with two main types, (1) fluorescent, materials which emit a useful amount of light only while they are being irradiated, and (2) phosphorescent, materials which continue to emit light after the source of irradiation has been removed. A method of testing brightness and the standards of brightness to be reached by the various raw materials are given. A list of the available commercial lamps for this work is supplied.]

Salt Cellar Cap

Treforest Trading Estate.

The Editor, *Plastics*.

Dear Sir,—We beg to hand you enclosed one cap of a salt pourer, and should like to know which firm is manufacturing it. Could you, perhaps, tell us the address for this article, or addresses of manufacturers of caps for salt and pepper pourers in other shapes of Beetle? We should be very much obliged to you to get your information at an early date.

MENDLE BROTHERS, LTD.

[EDITOR'S NOTE.—We cannot know the manufacturers of the actual specimen as there is no mark on it. Most of the moulding concerns have made similar ones. You might try some of those listed in our Directory. Will those interested please write direct?]

Rope Preservatives

Glasgow.

The Editor, *Plastics*.

Dear Sir,—We are interested in preserving hemp ropes, including fishing nets, and are anxious to know whether synthetic resins have been used for this purpose. As most ropes and all nets have to withstand bacterial and fungus growth and salt water, this must be remembered in suggesting a material. F.G.A.

[EDITOR'S NOTE.—We believe most synthetic resins are out of the question, as the rope or net must be treated by dipping in a solution and merely allowed to dry. Treated with, say, phenol-formaldehyde resin, the impregnated material would probably be brittle and powder away. On the other hand, our knowledge on this point is scanty and resin manufacturers may have other ideas. A thermoplastic resin soluble in, say, benzene, such as "acrylic" or polystyrene resins, should prove of considerable use, owing to high resistance to water. Cost, however, will probably eliminate their use. It might be worth while trying a mixture of tar and a small percentage of, say, "acrylic" resin, the whole dissolved in naphtha.

Considerable progress has been made with the resin-like copper, zinc, iron and aluminium naphthenates alone, or admixed with tar. These have already been used for the purpose with considerable success. The copper salt is green, the zinc pale yellow and the iron is dark brown in colour. The use of aluminium naphthenate, which is a rubbery compound and very water resistant, is also recommended. The other three are strong fungicides.]

Switches

Belfast.

The Editor, *Plastics*.

Dear Sir,—We are very anxious to get in touch immediately with the manufacturers of "Goltone" Bakelite switches and shall be glad if you will kindly forward, as soon as possible, the name and address of the plastic manufacturer making up under this name. The line we require is a small electric bulb holder which is being retailed at 3d. in Woolworths. The only clue on the holder, which is of Bakelite, is the moulded name "Goltone." As this is required for national work, we feel sure you will assist us.

THE FLEET LEATHER MFG. CO., LTD.

[EDITOR'S NOTE.—We do not know the name of the actual manufacturers, but judge "Goltone" to bear some similarity to their name. You might try Ward and Goldstone, Ltd., Pendleton, Manchester, 6, who make or sell similar electrical equipment for the multiple stores. Alternatively, any of the moulding concerns mentioned in our Directory can make similar ones.]

TRADE AND PERSONAL NOTES

W. Edwards and Co., Allendale Works, Southwell Road, Loughboro' Junction, London, S.E.5, have sent us particulars of their new metal jet pumps. Previously the majority of these were imported from abroad, but because of Messrs. Edwards's long experience with pumps and realizing the urgent need for a British-made unit, this new type was developed at their Allendale Works. After exhaustive experiments the pumps were subjected to vigorous tests and gave a performance definitely superior to the imported type hitherto supplied. These pumps are extensively used in all types of laboratories and are recommended for use in works laboratories throughout the plastics industry. The pump costs 14s. and gives the lowest possible vacuum, 12 mm. mercury. High speed is maintained at a water pressure of only 15 lb. per sq. in.

Lord Dudley Gordon has been elected president of the Federation of British Industries. Lord Dudley Gordon, who is ex-President of the British Engineers' Association, has served for a number of years on the Grand Council and was a few months ago appointed deputy president of the Federation.

The Institute of the Plastics Industry, Windsor House, Victoria Street, London, S.W.1, is asking for the co-operation of members in promoting the working of the Institute during the present emergency. It is the intention of the Council to encourage local section officers to arrange meetings where possible, and it is hoped that many informal debates will be arranged, which will not, of course, be reported. The "Transactions" of the Institute will be published thrice annually, as long as sufficient paper is available. All members will be asked to contribute articles on technical subjects and particularly those who have knowledge to impart but have hesitated to face a meeting of their fellow members. Those who have prepared papers for the present session are to be asked to allow these to be printed without necessarily being read at the meeting. Members who have not paid current subscriptions are to be asked to do so, as the funds of the Institute are to be maintained on a sound basis for future development.

The London Shellac Research Bureau, India House, Aldwych, London, W.C.2, have published a pamphlet describing the work done by K. E. Lalkaka (in the Chemical Engineering Laboratory of University College, London, on behalf of the Indian Lac Cess Committee and under the supervision of Prof. H. E. Watson) towards fusing pulverized shellac by passage through a flame and projecting fused particles upon a surface to form a well-bonded coat. The technique of the new method is described, and the following surfaces have been satisfactorily treated by the process:—Wood, paper, tin, aluminium and copper sheet, concrete, glass, asbestos, board, plaster, castings and porous stoneware.

Albright and Wilson, Ltd., Shell-Mex House, Strand, London, W.C.1, have sent us a descriptive booklet dealing with Manucol, a chemically reactive colloid, recommended for creaming rubber latex. The substance resembles the vegetable gums, in that it forms viscous solutions in water. Two grades are available: Manucol 1 and Manucol V, the latter giving solutions approximately 10 times as viscous as Manucol 1. The viscosity of each grade is controlled within close limits. It is reactive and will give gels with salts of calcium, aluminium and many other metals.

General Electric Co., Schenectady, N.Y., U.S.A., have sent us an interesting leaflet dealing with electric heat in modern industry. The publication is profusely illustrated and depicts heating operations in a number of important industries.

Watkins and Watson, Ltd., 17, White Lion Street, London, N.1, remind us that they are now specializing in A.R.P. ventilation, and will welcome inquiries from concerns requiring advice regarding problems connected with their shelters.

Metal Propellers, Ltd., Purley Way, Croydon, Surrey, are specializing in the production of plant made of stainless steel, and will welcome inquiries from manufacturers interested in jacketed pans and stills of all types.

"Design in Daily Life" was the title of a paper read by Mr. Reco Capey, R.D.I., A.R.C.A., at the Royal Society of Arts, John Street, Adelphi, London, W.C.2, on January 24, 1940. The lecture was illustrated by lantern slides and specimens, and created a good deal of interest.

The Councils of the Chemical Society have formed an Advisory Research Council, whose main function will be to bring to the notice of those engaged in chemical research subjects for investigation likely to be of potential value to the nation at the present time. It is hoped to effect a liaison with Government Departments and industrial organizations, and to amplify in every way possible the valuable work of the Department of Scientific and Industrial Research.

T. H. and J. Daniels, Ltd., Lightpill Iron Works, Stroud, Glos, have forwarded us their latest rubber catalogue, which gives full particulars regarding their wide range of plant, including standard-type vulcanizing presses, hydraulic pumps, hydraulic accumulators, hydraulic valves, hydraulic presses, press platens, steam vulcanizers, etc. The London office of the company is now Craven House, Kingsway, W.C.2, and not Regent House, Kingsway, W.C.2. The telephone number has not, however, been altered and is still Holborn 3232-3233.

National Savings Committee, whose Press office is Bouverie House, Fleet Street, London, E.C.4, have drawn our attention to the national need for publicity designed to promote saving. Organizations desiring information concerning any phase of the present campaign should get into touch with the Honorary Publicity Advisers.

The Iron and Steel Scrap Campaign will, it is hoped, soon be in full swing. Already some 150,000 individual firms have been approached and, as a result, additional scrap has been secured that would have taken ten or a dozen ships to bring to our shores if it had had to be imported. The importance of this will be realized when it is remembered that in 1913 the tonnage on the U.K. Register was 5,017 ships of 16,576,000 total tonnage, as against 3,325 of 13,952,000 tonnage in 1938. Industrial concerns, farmers and private individuals are asked to co-operate with the Director of Scrap Supplies, Mr. George Wood, so as to build up a vital reservoir of scrap metal which can be turned into the munitions of war.

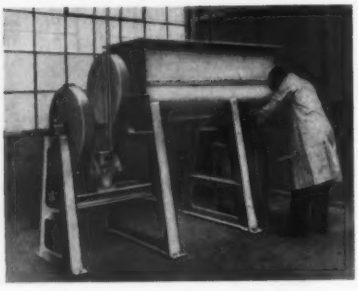
The Plastics Group of the Society of Chemical Industry met at Caxton Hall, Caxton Street, Victoria Street, London, S.W.1, on January 26, at 6.30 p.m. The meeting was arranged as a joint symposium with the Faraday Society, and was entitled "Molecular Size and Structure and their Influence on the Properties of Plastics." Many members took part in the discussion which followed.

B.L.F. (Birmingham), Ltd., with registered office at 25, Bennetts Hill, Birmingham, is a private company, registered December 20, with a capital of £7,000. The object of the company is to further the interests of an association of producers of Bakelite lock furniture called the B.L.F. Association, to foster and encourage the use of Bakelite and other synthetic resinous materials, etc. The first independent chairman is Eric L. Heathcote.

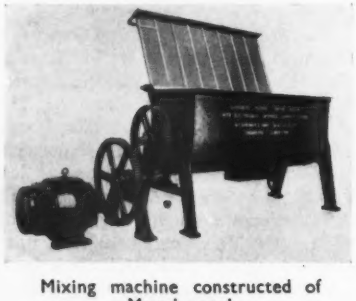
NEW MATERIALS—NEW PLANT—NEW METHODS

"Rapid" Mixing Machines

Wm. Gardner and Sons (Gloucester), Ltd., Bristol Road, Gloucester, have just sent us particulars of their well-known mixing machines. The Gardner Patent "Rapid" Mixer illustrated is constructed of Monel Metal and is specially recommended for mixing operations where corrosion is feared; they can also be made of stainless steel or other materials if necessary. This machine is direct coupled to an electric motor by spur gearing and it is fitted with a safety cover which is closed during running; opening the cover stops the machine automatically. Another popular mixer is the Large Capacity Patent "Rapid" Mixer fitted on high stands, which is coupled to the electric motor by means of chain drive. The machine is fitted with a special sleeve connection for discharging into receptacles, as shown.



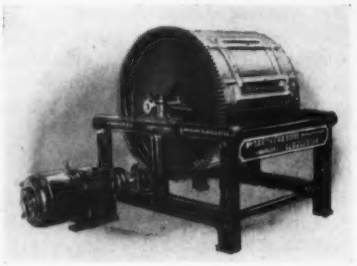
Large capacity mixing machine.



Mixing machine constructed of Monel metal.

The third mixer in the series is known commercially as Gardner's Drum Type Mixer, and it is coupled to an electric motor by means of flexible coupling. This machine is rather different in construction from the machines referred to above, being more or less used for materials of a granular nature, whilst the two former types are generally used for materials in powder form.

All these mixers are applicable for drive by belt or for direct coupling to electric motors and all types are made in a large range of sizes. The horizontal type of machine can be supplied with mixing agitators of various forms to suit particular working conditions. The machines are also designed for ease of cleaning and may be supplied with enamelled interiors or constructed of special metals to resist corrosive action.



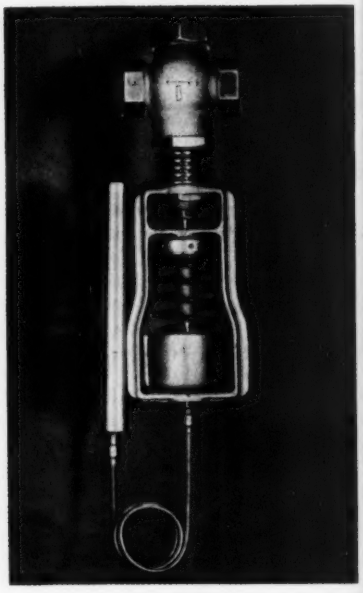
The Drum type Mixer.

Gardner's mixers are extensively employed in the plastics industry for all kinds of mixing operations and the manufacturers deserve great credit for the way in which they co-operate with the industry to solve all mixing problems.

Thermostatic Steam and Water Valves

We have just received particulars from The British Thermostat Co., Ltd., Sunbury-on-Thames, Middx., regarding their PCV thermostatic steam and water valves. These are primarily intended to regulate automatically the flow of water or low-pressure steam in order to maintain substantially constant temperature conditions at the point of control. They are suitable for a very wide range of applications in central heating, air conditioning and industrial practice, and have the great advantage that they give a proportioning or "modulating" control, that is to say, the valves do not give a simple "open-shut" operation, but a progressive opening, the extent to which the valve is open at any time being directly related to the departure of the temperature at the sensitive phial from the temperature it is required to maintain.

The valve is operated by a seamless metallic bellows which is connected by a capillary tube to a bulb or phial charged with a volatile liquid. The phial is located in a position where it is exposed to the temperature to be controlled.



Example of the PCV valve made by the British Thermostat Co., Ltd.

Increase of temperature at the phial results in a corresponding increase of vapour pressure in the charged system, and decrease of temperature results in a corresponding decrease of vapour pressure. This change of pressure operates the valve progressively. Movement of the bellows is opposed by a spring, the load of which can be adjusted in order to pre-set the temperature to be maintained.

The chief applications of the PCV thermostatic valve are for the control of industrial processes, notably processes using comparatively small flows of low-pressure steam for raising the temperature of vats, drying ovens and the like.

The valves are also suitable for governing the flow of steam to vaporizers employed in humidity control, in which case the sensitive phial should be employed under wet-bulb conditions.

PCV valves may also be employed for controlling calorifiers, pasteurizing plant, and steam heating and processing in general, and also in air-conditioning systems for controlling sprays and the supply of cold water to unit coolers in dew-point-controlled installations.

Two standard sizes, $\frac{1}{2}$-in. with $\frac{1}{4}$-in., also a $\frac{3}{4}$-in., are available.